AERO DIGEST

NOVEMBER 1941 35 CENTS

INCLUDING

AVIATION ENGINEERING

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produced for Great Britain

rthrop's Flying Wing
Fighter's Striking Power
ish Aircraft Maintenance
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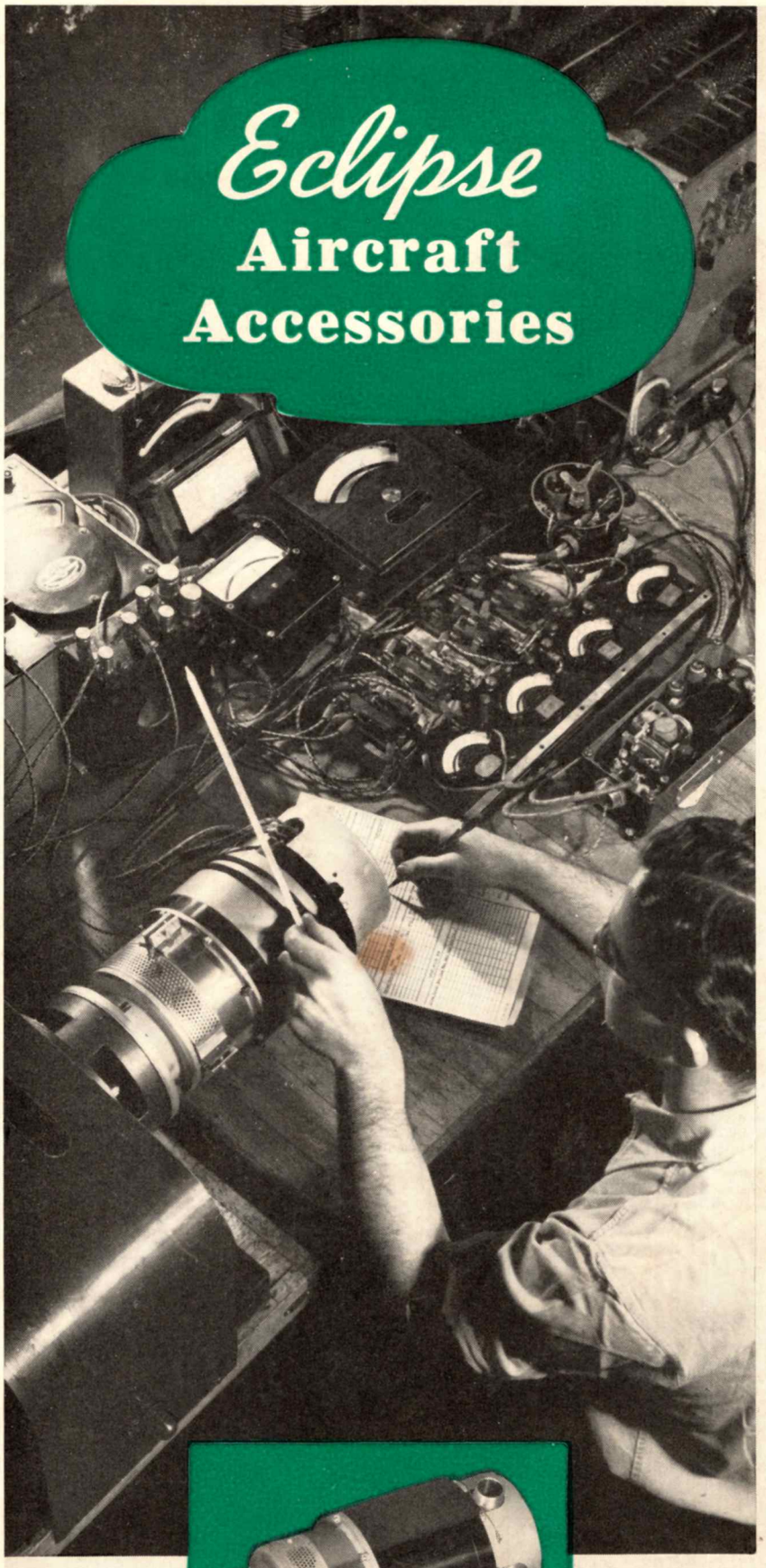
Eclipse Aircraft Accessories



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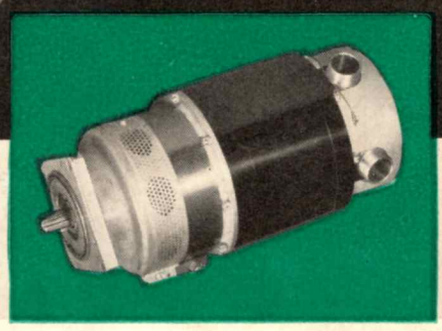

Above: Generator Performance Test—Eclipse Production Test Department

Left: Typical AC-DC Generator for Battery Charging and Radio Power Supply

ECLIPSE

LET'S GO! U.S.A. KEEP 'EM FLYING!

AERO DIGEST Volume 39 | NOVEMBER, 1941 Number 5

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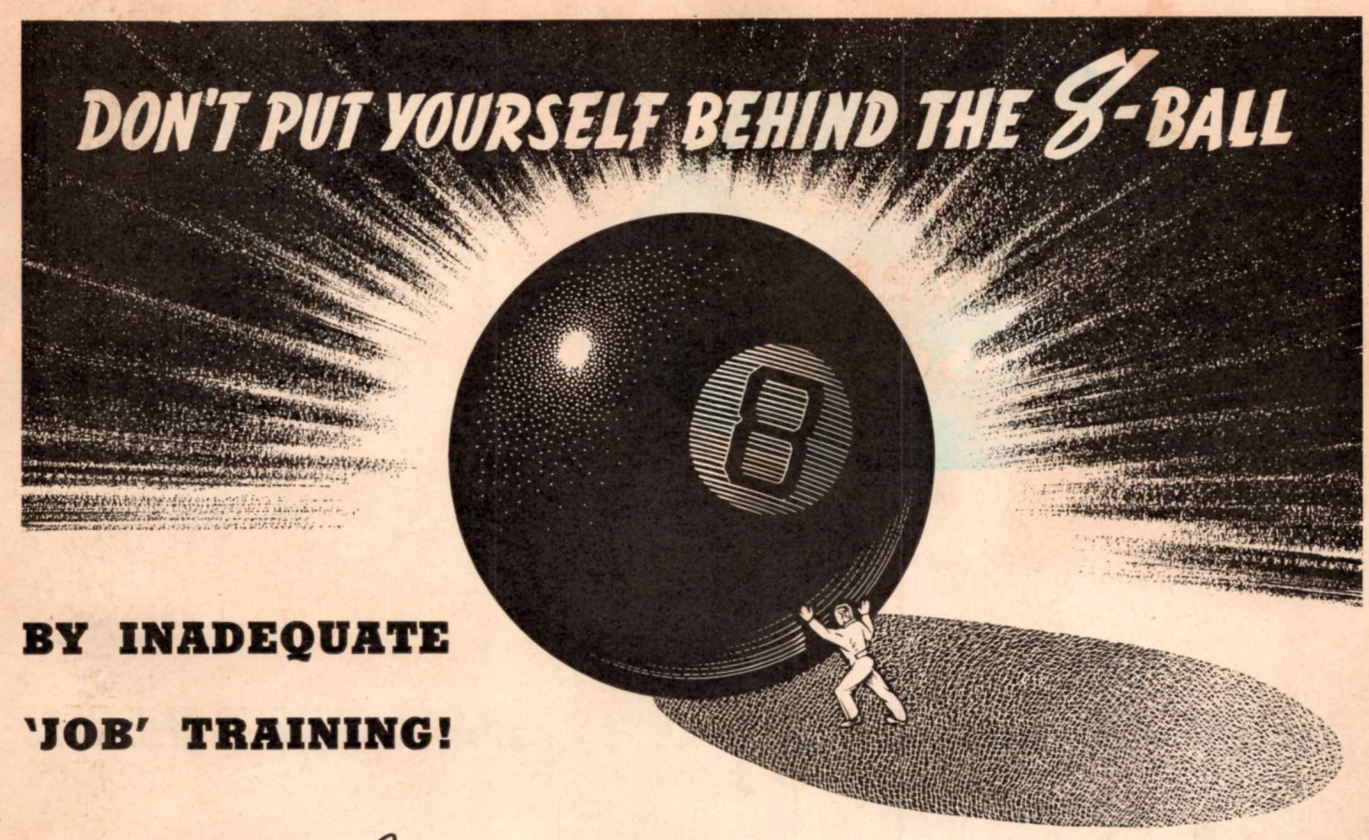
DON'T PUT YOURSELF BEHIND THE 8-BALL



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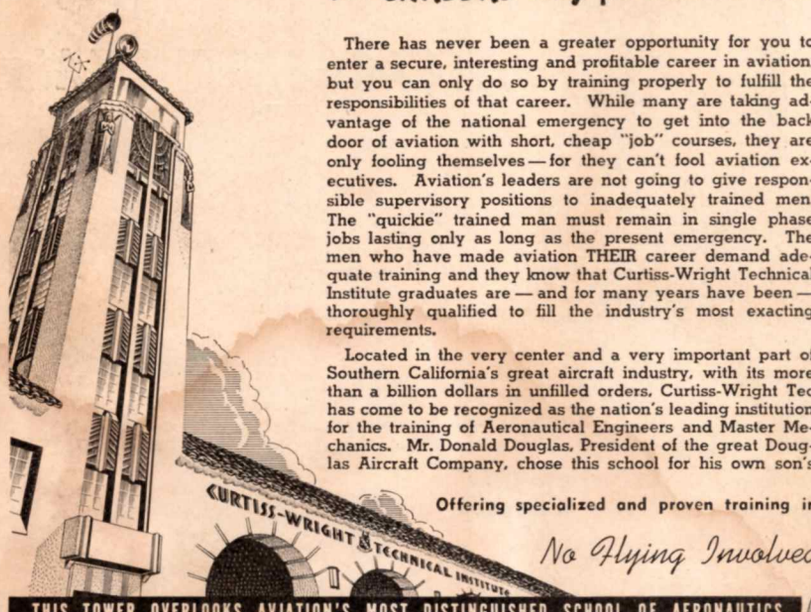

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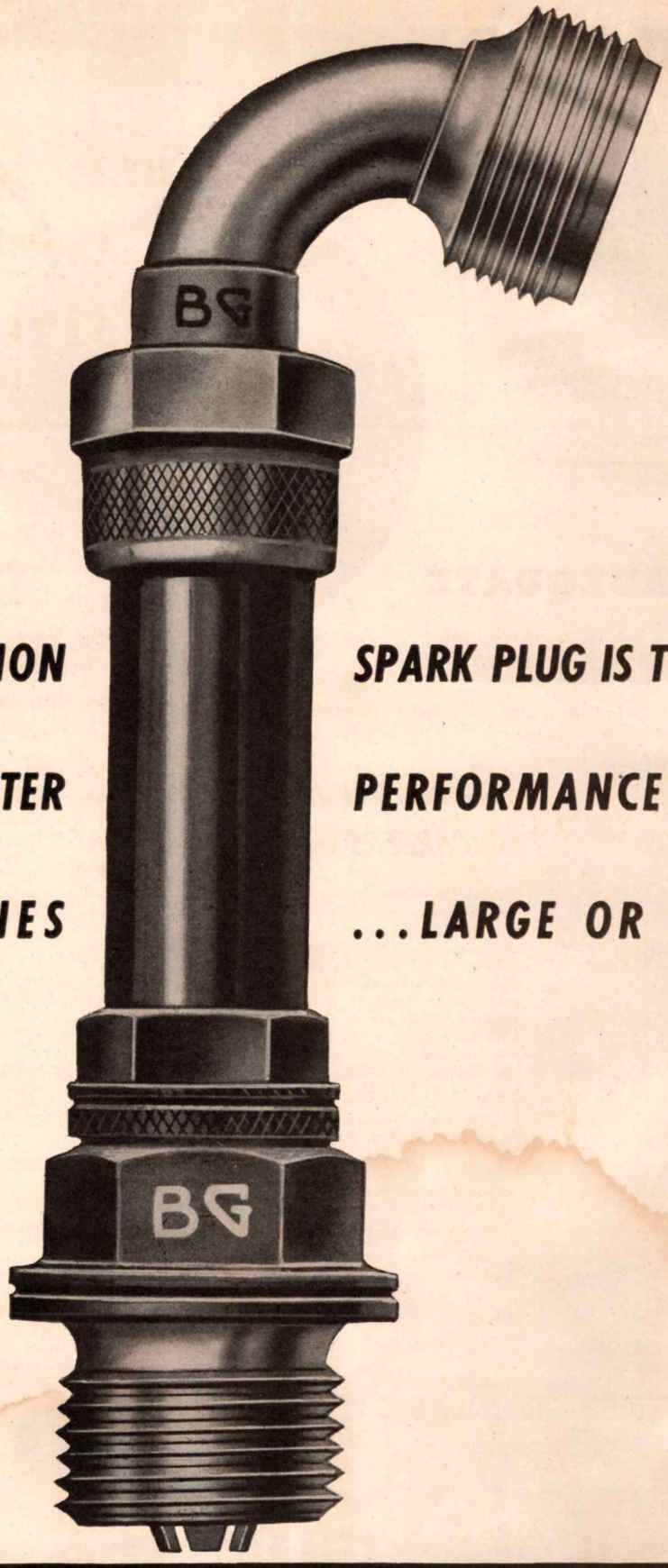

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AERO DIGEST

including

AVIATION ENGINEERING

An ABC Publication

VOLUME THIRTY-NINE NUMBER FIVE

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BILLY'S been slipping off with the Sandman before Daddy gets home these days.

Putting in 60 hours a week like Dad does making Kollsman Aircraft Instruments doesn't let a fellow get home too early.

But it's sure a big help to Uncle Sam.

Every hour of the 60 calls for skill. But you just can't turn out men as expert as Dad, overnight!

Sure, we've got as many skilled master craftsmen as we can find. And we're training promising young men and women as fast as possible.

They're *all* putting in plenty of overtime. But we realize that even the extra pay can't compensate for priceless hours spent at home with the wife and family.

For these personal sacrifices, this unselfish devotion to the nation's welfare, Kollsman...and America...are grateful.

ACHIEVEMENT

During the past two years Kollsman has increased personnel 322 per cent; instrument production 504 per cent. Production continues to increase, in keeping with the high standards of Kollsman precision.

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Division of

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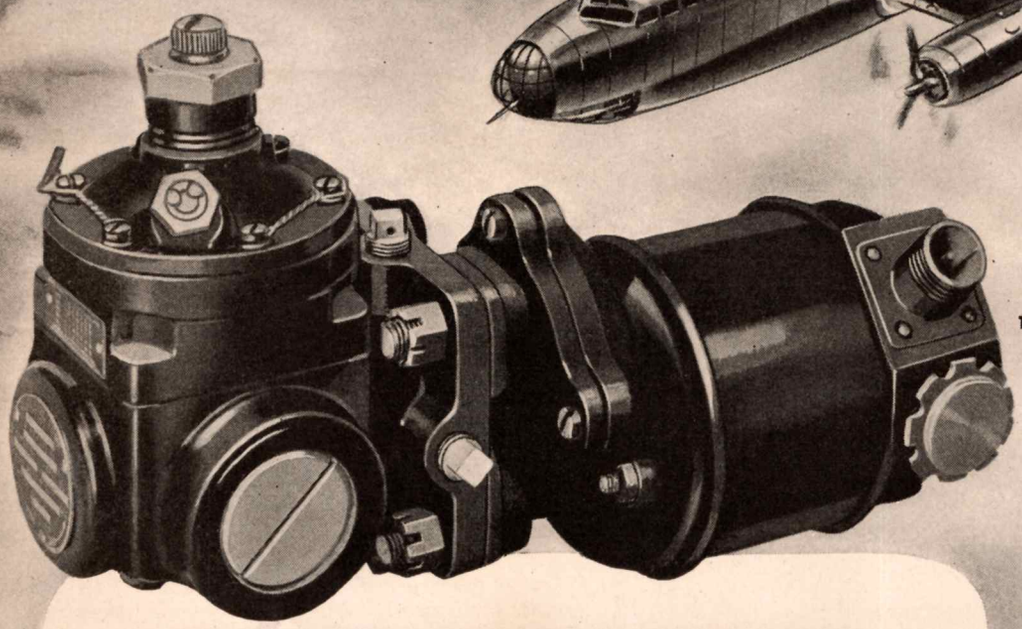
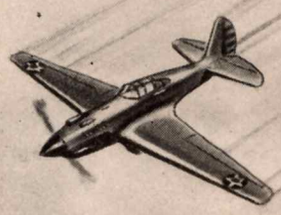
3.8 to 5 pounds saved-



1. PESCO Stand-by Fuel Pump—a standard pump with new light-weight motor. Pump has diaphragm type relief valve with pressure regulation balanced to atmospheric conditions.



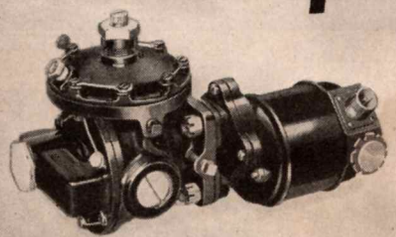
WITH THESE NEW

PESCO *motor driven Fuel Pumps*

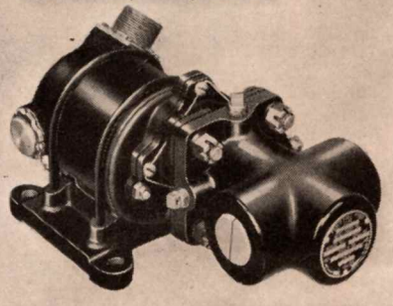
• In modern planes requiring as many as 5 auxiliary fuel pumps, a saving of several pounds per unit represents a substantial total. The new PESCO fuel transfer and stand-by pumps feature compact, high-speed motors with gear-reduction drive and actually weigh 3.8 to 5 pounds less than former models. The explosion-proof motors meet latest Air Corps specifications and are available for 12- or 24-volt systems. In addition to the models illustrated, other units can be supplied for special requirements.

SPECIFICATIONS AND PERFORMANCE DATA ON PUMPS ILLUSTRATED

	Capacity G. P. H.	Pressure P. S. I.	Motor Hp.	Amps.	Volts	Weight Lbs.
1. Three Sizes	225	20	1/10	5	24	5.8
	350	20	1/8	8	24	7.0
	350	15	1/8	6.5	24	7.0
	650	8	1/8	7	24	8.5
2. One Size	325	18	1/10	6	24	8.2
3. Three Sizes	280	5	1/10	3.8	24	5.0
	360	15	1/8	7	24	6.6
	650	8	1/8	7.2	24	6.8
Can be supplied with or without motor base. Base weighs 0.2 lbs.						



2. PESCO High Altitude Fuel Pump—with variable displacement for pressure regulation, eliminating internal vapor lock encountered at low atmospheric pressures.



3. PESCO Fuel Transfer Pump—a standard positive displacement pump with new motor. Model illustrated shows motor with base.

PUMP ENGINEERING SERVICE CORPORATION

DIVISION BORG WARNER CORPORATION ★ 12910 TAFT AVENUE ★ CLEVELAND, OHIO

"There are Hundreds More . . .

on the way to help finish the job"

On the occasion of his visit to the Consolidated plant, Lord Halifax inscribes a message to the British Prime Minister on the tail surfaces of a Liberator.

NIGHTLY from Newfoundland echoes the thunder of departing warplanes—heavy bombers taking off for destinations "Somewhere in England." Conspicuous among these are the Consolidated Liberators, long-range, high-speed, four-engine, 20-ton bombers, equipped with Curtiss Electric Propellers.

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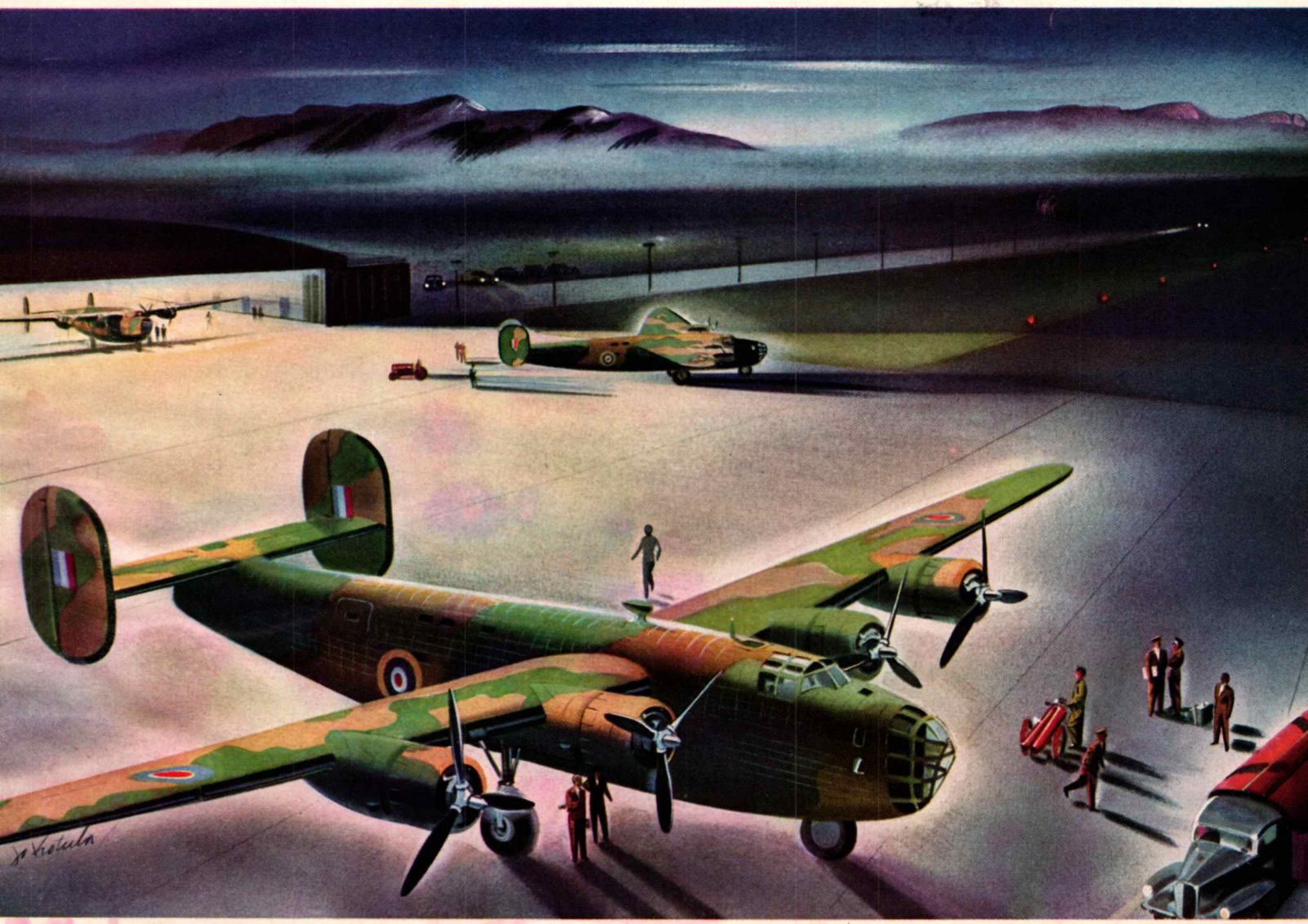
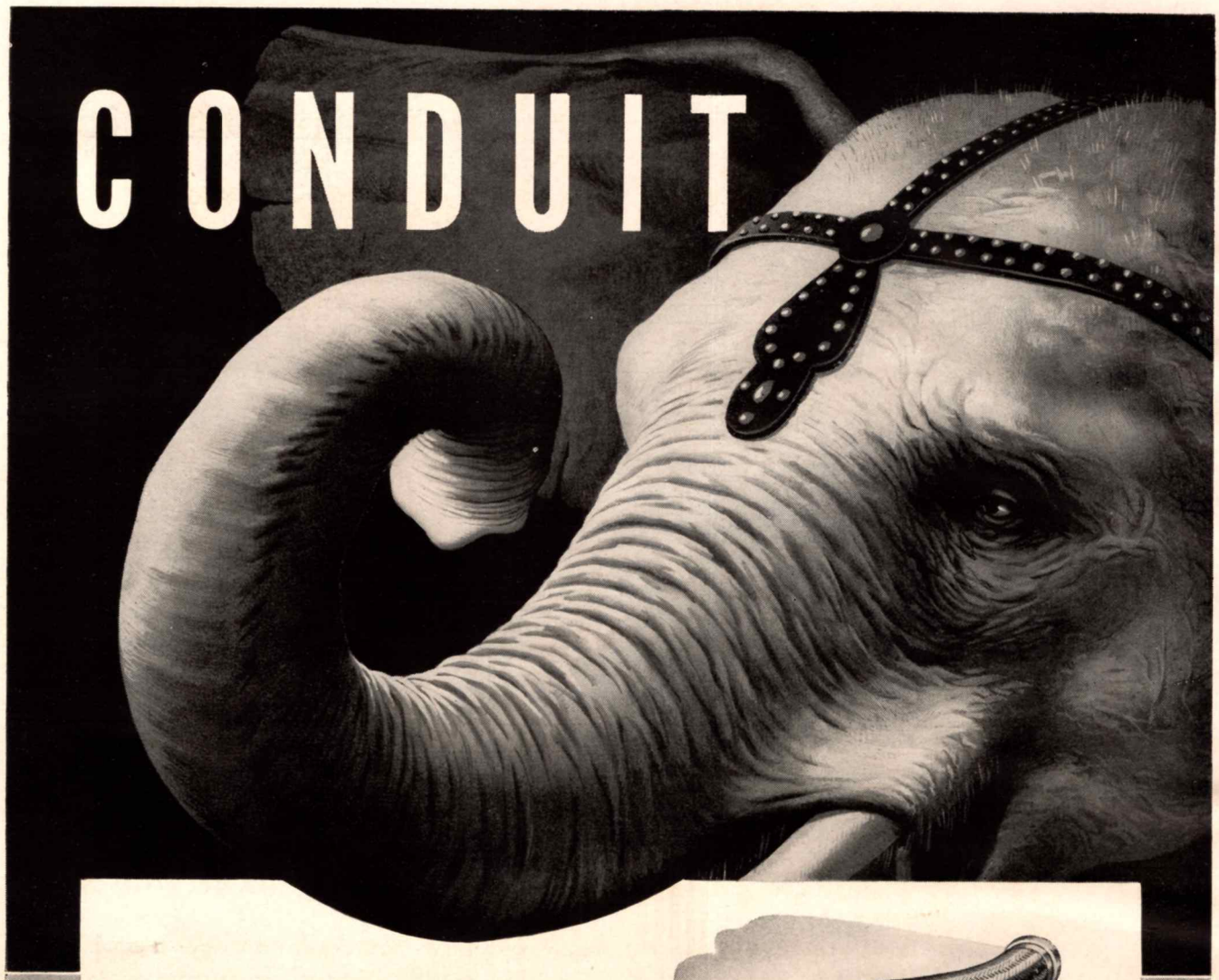
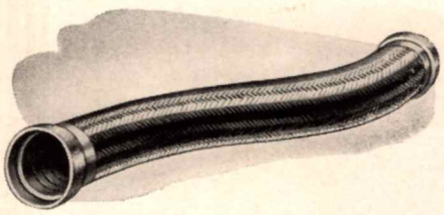


CURTISS *Electric*
PROPELLERS



Long-Lived, Flexible, *and TOUGH*



Into the construction of a single large airplane go literally miles of flexible conduit. Its multiple purposes include shielding high tension ignition and low tension secondary systems, guarding against absorbing or radiating radio frequency interference, providing air ducts, housing flexible shafts. At all times, under all conditions, it must function efficiently and dependably.

Breeze Flexible Shielding Conduit represents years of engineering and production experience. Manufactured in strict accordance with U. S. Government specifications, its ruggedness offers dependable, enduring resistance.

Used in conjunction with Breeze Conduit Fittings, Breeze Flexible Conduit makes it possible to arrange assemblies to meet any shielding requirement.

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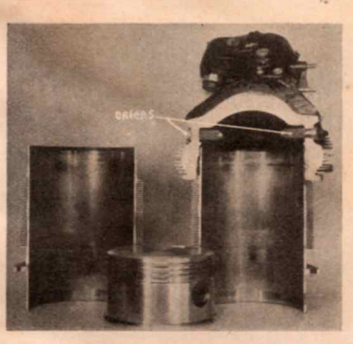

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AIR PILOTING brings you the information you need, organized into one compact, inexpensive manual. Based throughout on the specific requirements of the Civil Aeronautics Administration, the flight test maneuvers are completely analyzed and explained, with clarifying diagrams, fine points of the technique of execution clearly shown, faults to avoid pointed out, and ways to correct these faults indicated. In short, *Air Piloting* supplies a detailed, step-by-step system of instruction from first solo on to instrument flying.

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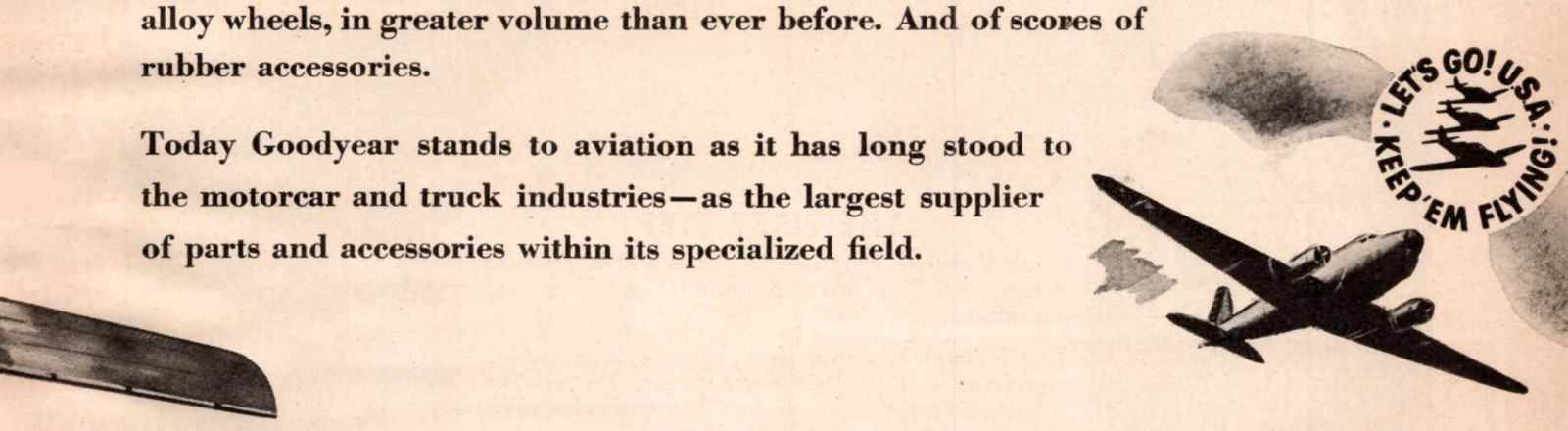

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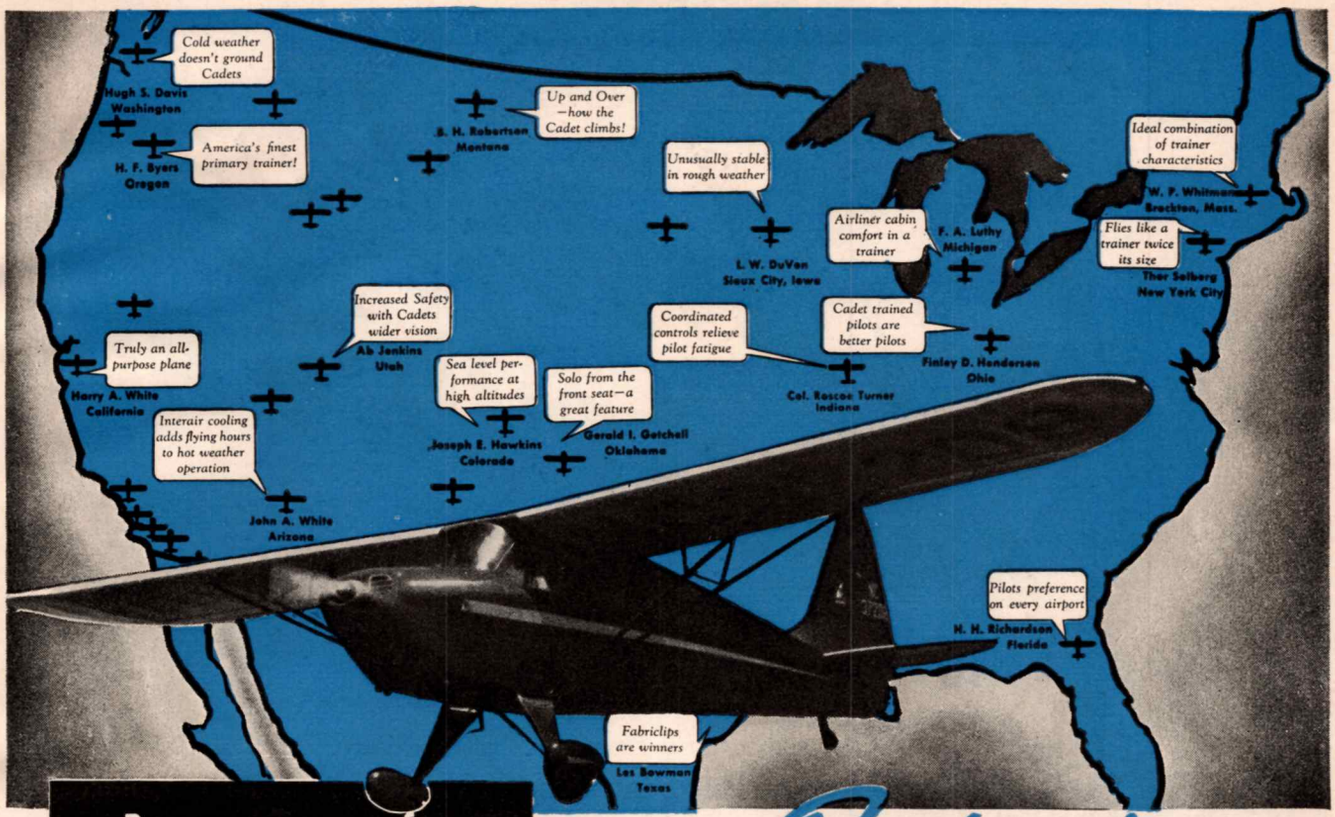
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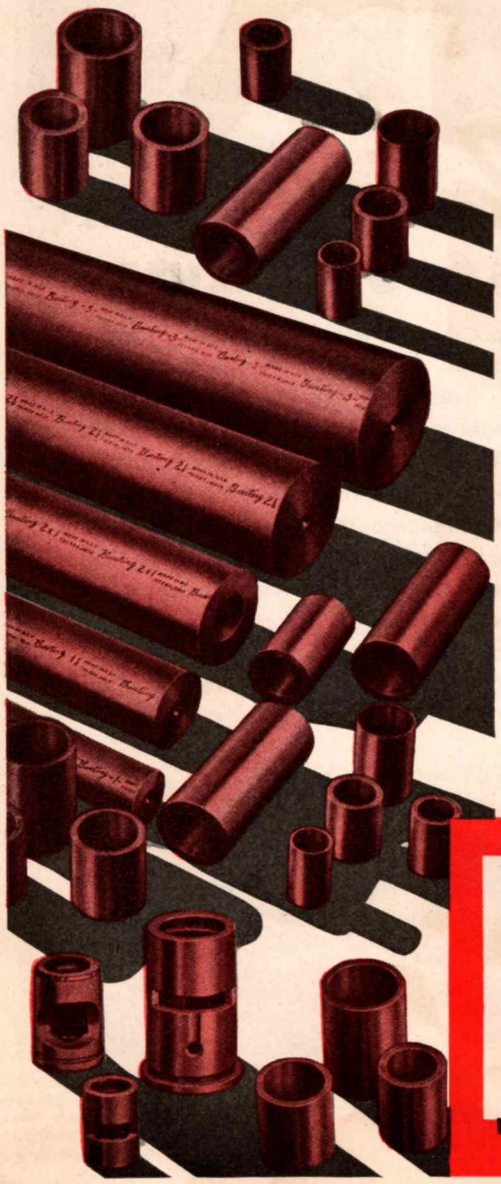

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PRECISION BEARINGS INDUSTRIES

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Send your blue prints to Toledo or write and let us advise you how to engineer the application with a Bunting Bronze Standardized Bearing which you can get without delay . . . The Bunting Brass & Bronze Company, Toledo, Ohio. Warehouses in All Principal Cities.

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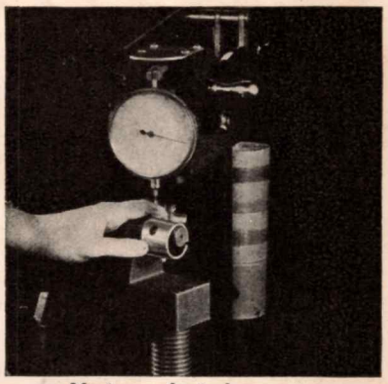

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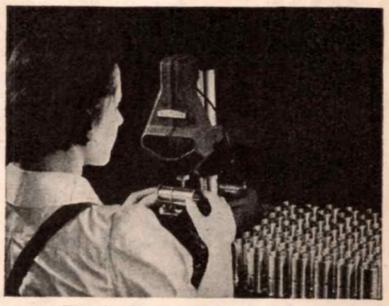

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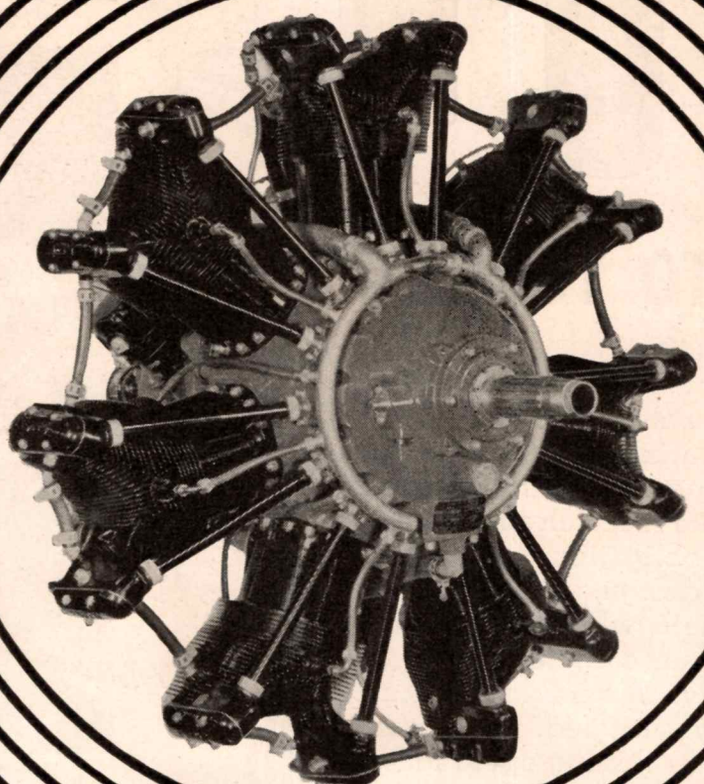

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Powered for top speed drilling . . . **designed** for quick, easy handling . . . and **built** to stand up under constant, heavy duty operation—that's the new Thor U14FS 1/4" portable electric drill! It develops approximately **twice the power** of similarly rated, production duty electric drills, yet weighs only 4 1/4 pounds, measures only 7 1/4 inches overall. The new Thor U14FS is tough and ruggedly built . . . with, for example, the field case, handle, and bridge cast in one solid, strongly reinforced piece. The side handle permits rapid, accurate movements in restricted space and the correct application of pressure. The momentary trigger switch can be locked for continuous operation. Two rubber bumpers protect finished surfaces.

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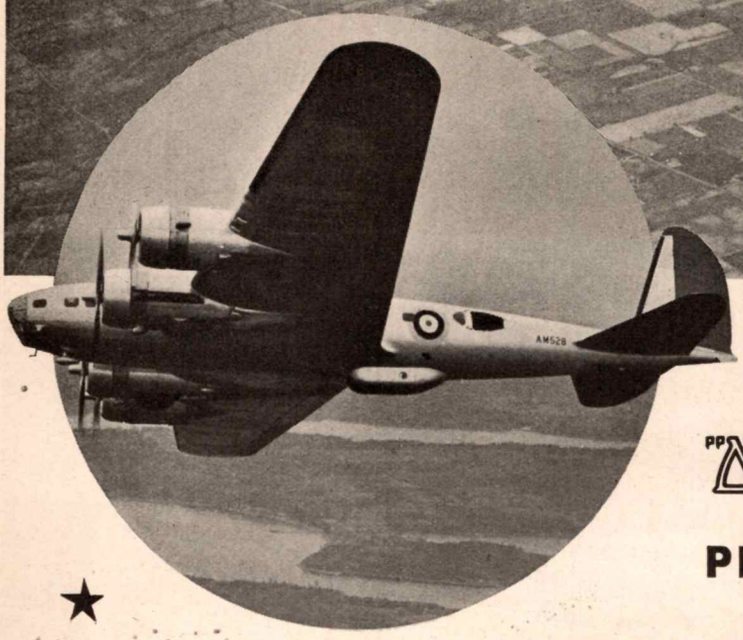

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PRECISION BALL, ROLLER AND THRUST BEARINGS

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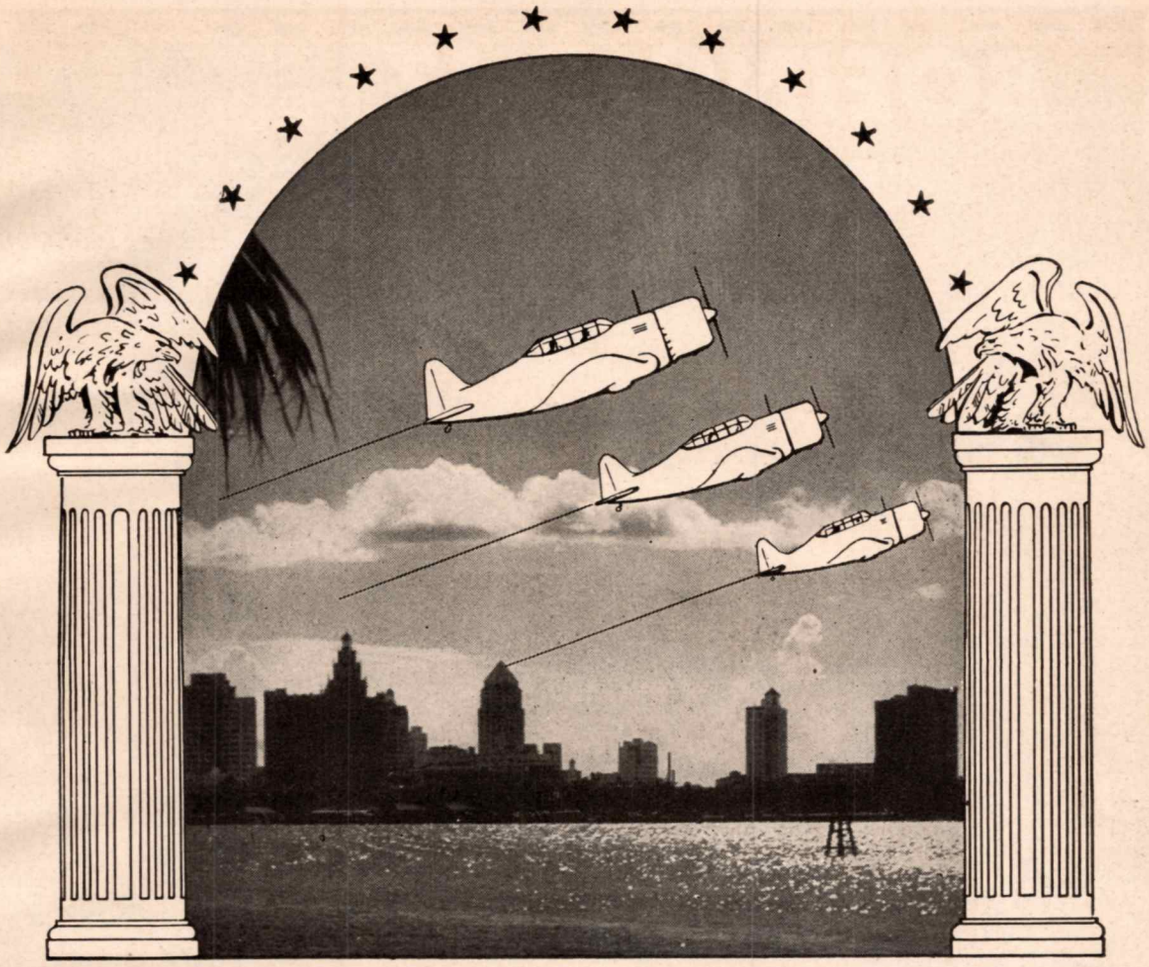
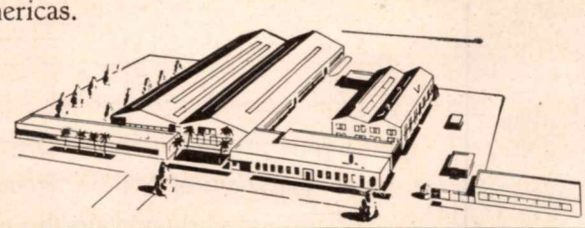


At Uncle Sam's Front Door

Miami, No. 1 airport-of-entry to the United States, assumes new importance today as the gateway to Latin America—and, via Africa, to all the world. Strategic is the location in this sub-tropical metropolis of Intercontinent's new plant . . . producing for war needs today . . . ready to build tomorrow's wings for the peacetime aviation of the Americas.



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MIAMI ALL AMERICAN AIR MANEUVERS OF 1942—JAN. 9-10-11

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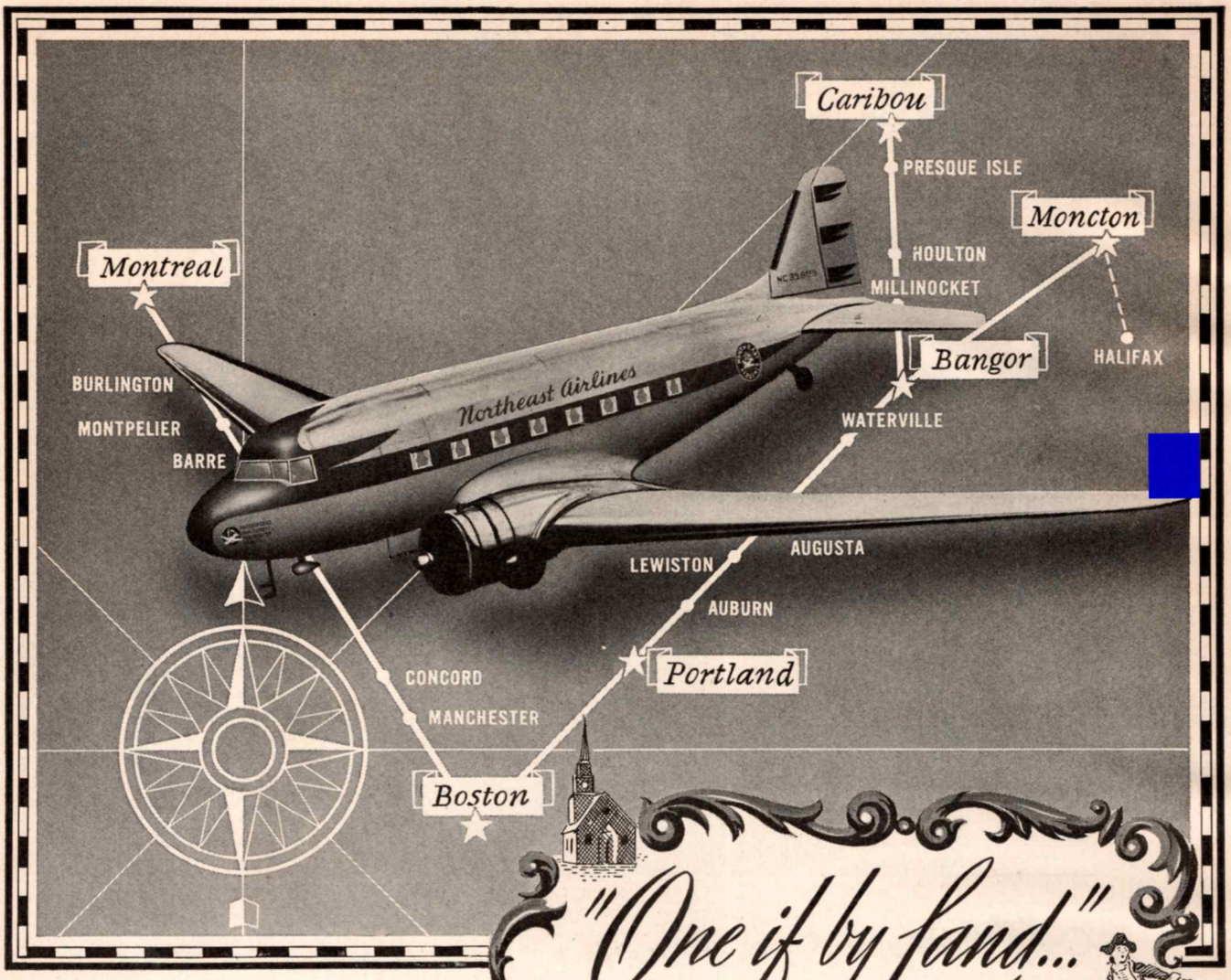

Northeast Airlines joins American, TWA and Braniff as users of the Sperry Automatic Radio Direction Finder

Down Boston way every radio station is a beacon for the new Douglas fleet of Northeast Airlines. The pilots, like modern Paul Reveres, speed their courses over historic New England, guided, not by a flickering light from old North Church tower, but by the precision indications of a Sperry Automatic Radio Direction Finder.

This instrument provides the pilot with relative, magnetic and true bearings without the necessity for calculation. Once tuned to a station, the Sperry Automatic Radio Direction Finder operates continuously and automatically even under precipitation static conditions. It is especially valuable for instrument approaches.

SPERRY GYROSCOPE COMPANY, INC.

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THE NAVY TRAINS WITH KINNERS

Official U.S. Navy Photograph

BEHIND the proven power of an ever increasing number of Kinner Engines, Navy pilots secure their primary training. Installed in Ryan NR-1 Primary Trainers, these efficient engines have increased the maneuverability and high performance of the Navy equipment. In every vital training program today—for the Navy, the Army, the C. P. T. P., and the British Commonwealth Air Training Plan—Kinner Engines are relied on for the dependability that has made them famous over the past 16 years.

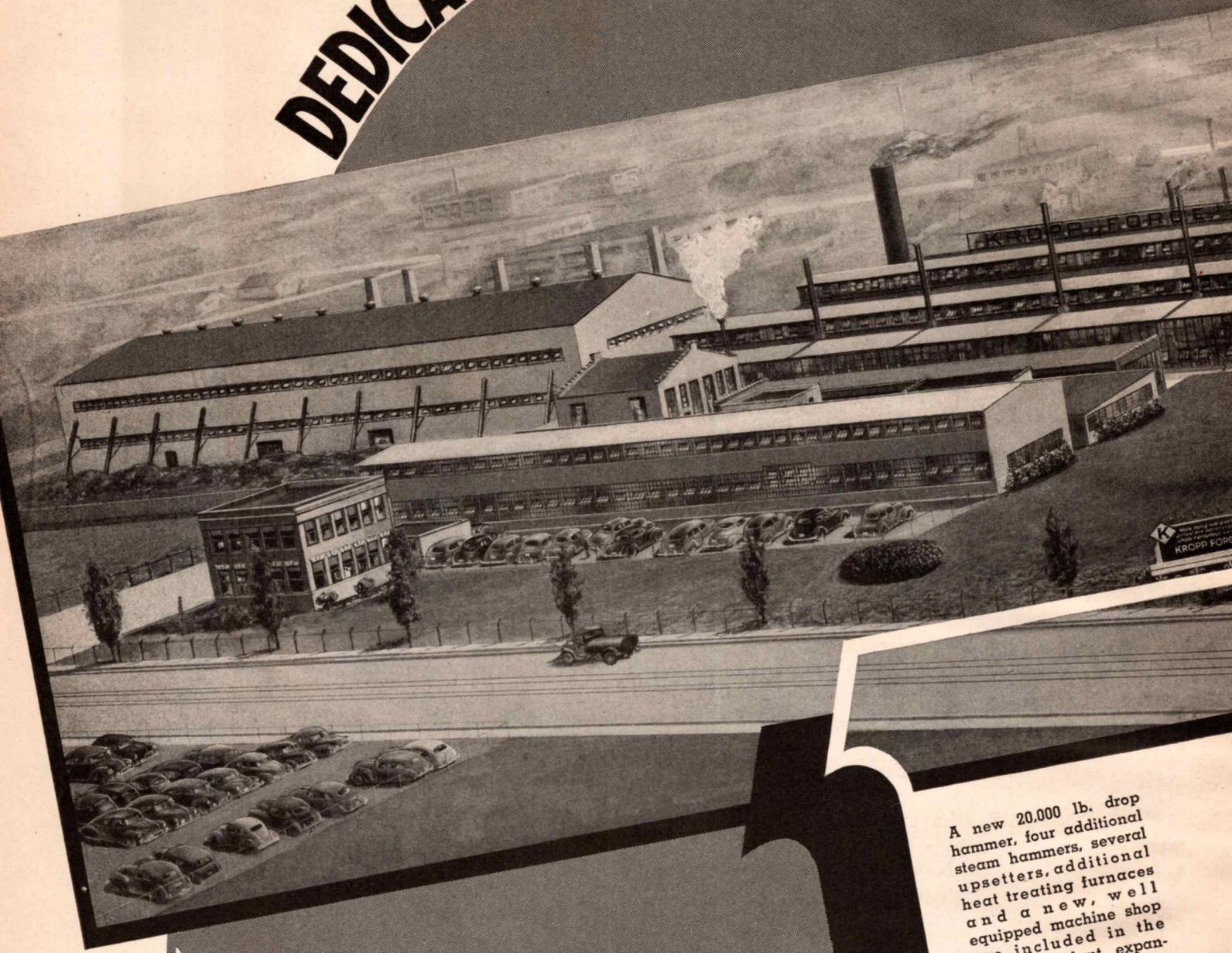
LET'S GO! U.S.A. KEEP 'EM FLYING!

KINNER ENGINES

KINNER MOTORS, INC., GLENDALE, CALIFORNIA

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

DEDICATED TO NATIONAL DEFENSE



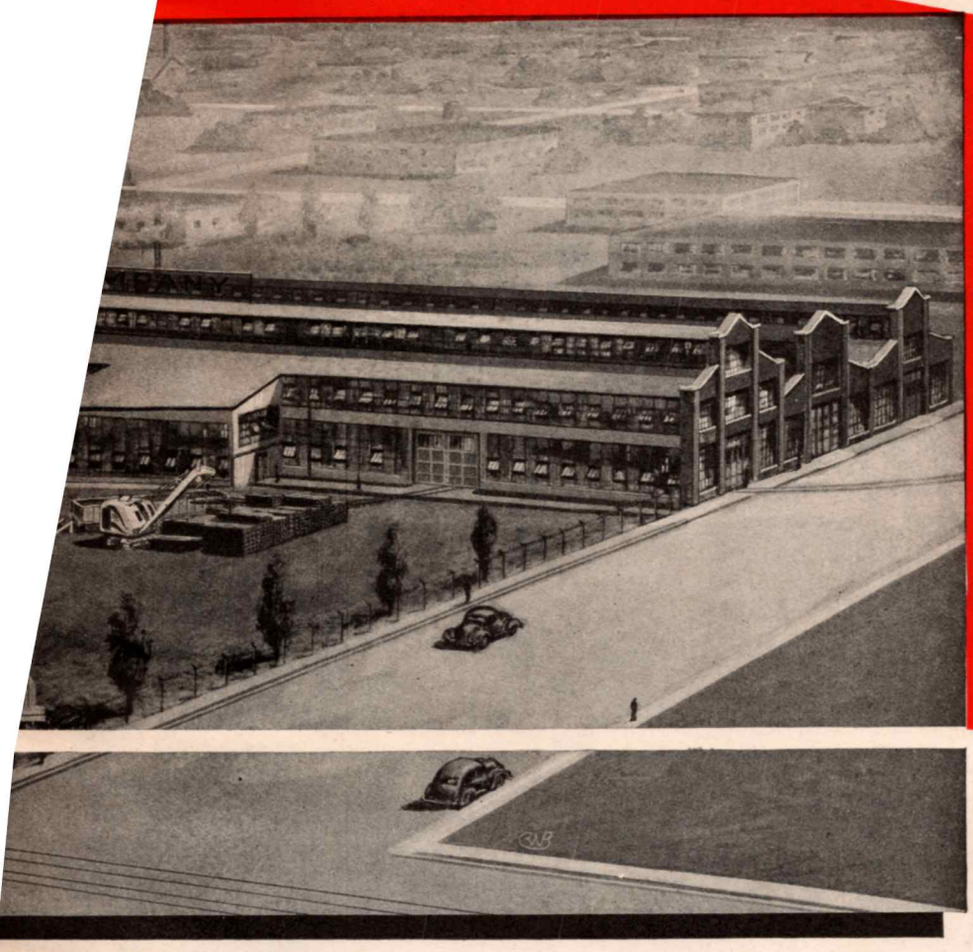
A new 20,000 lb. drop hammer, four additional steam hammers, several upsetters, additional heat treating furnaces and a new, well equipped machine shop are included in the $1,500,000 plant expansion program recently completed.

SERVING INDUSTRY 18 SINCE 37

K

KROPP FORGE CO.

OVER 100 YEARS



Greater stress resistance and a plus factor of safety are being built into more and more plane and engine parts with Kropp upset, drop and hammer forgings. Added strength in vital parts—strength that only tough forgings can provide — is assurance against failure in use during ordinary operation as well as under critical flying conditions. Kropp's modern forging practice, unequalled equipment facilities and 100% Magnaflux inspection of aviation forgings assure the ultimate in forging service for the flying industry. Specify forgings by Kropp!

KROPP FORGE COMPANY

World's Largest Job Forging Shop

5301 W. Roosevelt Road, Chicago, Illinois

Representatives in Principal Cities

KROPP

THE *Answers to Your Questions* ABOUT AVIATION TRAINING !

RYAN
SCHOOL OF AERONAUTICS
YOUR COPY FREE WHILE LIMITED SUPPLY LASTS!
RYAN SCHOOL OF AERONAUTICS,
Lindbergh Field, San Diego, Calif.
Gentlemen: Without obligating me in any way, please send me a free copy of "Life at Ryan." I may be interested in the courses I have checked.
AD 11-41
FLYING
MECHANICS
ENGINEERING
HOME STUDY
FULL NAME
STREET ADDRESS
CITY AND STATE
AGE
Please Print or Type
Life at Ryan

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

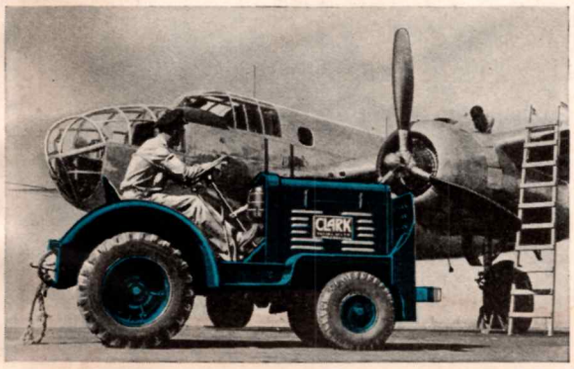
"CLARKS" save time and-

SHIPS are *vital*- TIME IS *precious!*

In Boeing's Seattle plant, "Clark" Fork Trucks speed production by moving materials and parts swiftly. They lift up to 3 tons, carry the load at 1 to 7½ m.p.h., tier it to 104 in., in 15 sec. Shown here picking up tail wheels for the Boeing 22-ton Flying Fortresses.

In factory, hangar and airport

—"Clarks" provide the speed and the 24-hr. continuous service demanded by the swift tempo of aircraft production and operation. Gas-powered, they maintain their rated speeds under load, climb ramps, never tire. Fork trucks for lifting, carrying, tiering—they speed manufacturing by keeping production machines supplied with materials and parts. Tractors — 4-wheeled and 3-wheeled — for pulling trailer trains, for towing and servicing ships in hangar and on the field.



"CLARKTOR-6" FOR TOWING SHIPS

"Clarktor-6"—four-wheeled, gas-powered tractor—serving on many a U. S. and British airfield—is shown here about to tow B-25 Twin Engine Bomber onto flight ramp at North American Aviation Company's field, Inglewood, Calif.

WRITE FOR CATALOGS

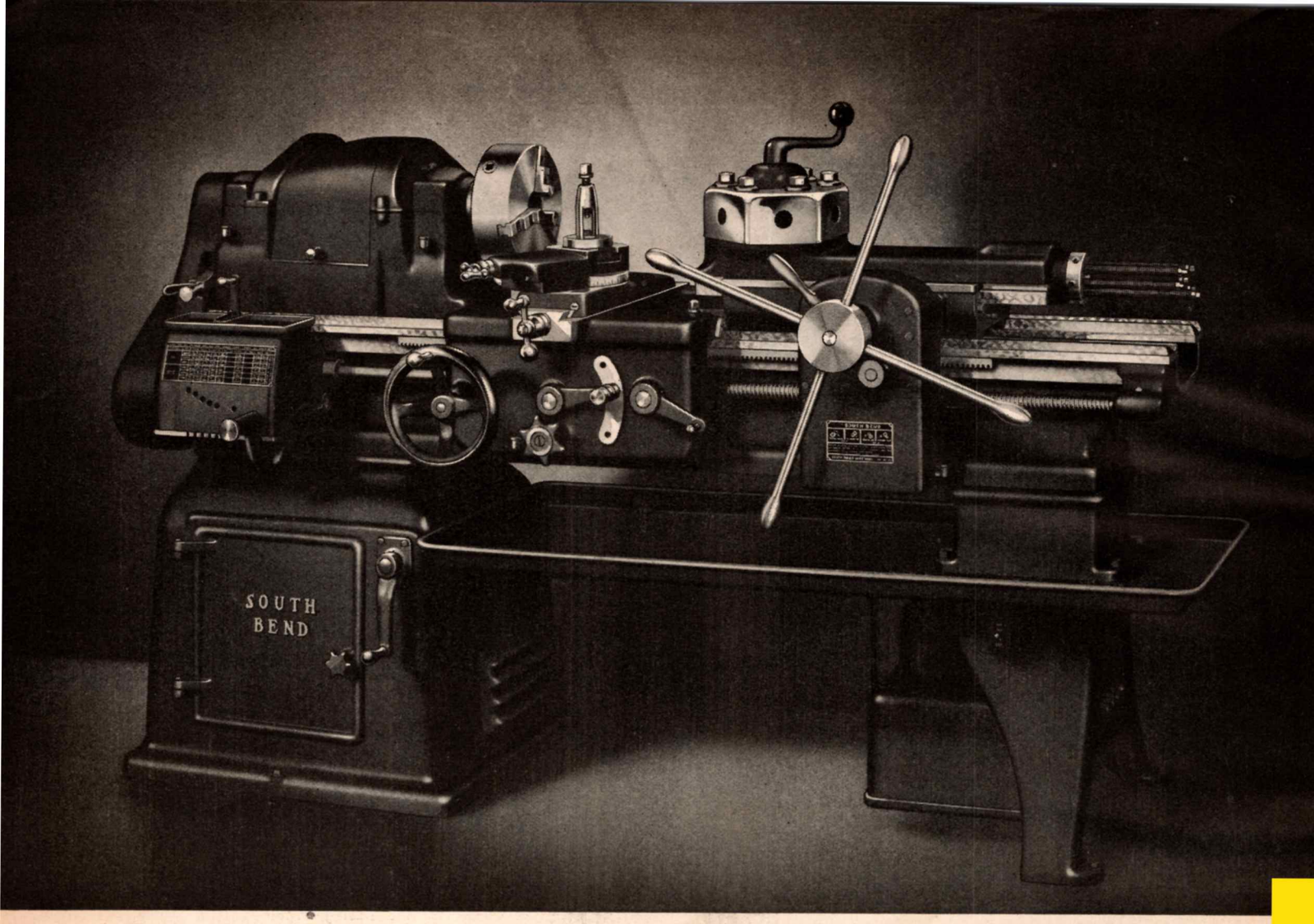
There are over 70 "Clark" Models. Tell us what your lifting, carrying, tiering or towing problem is—let us send you catalogs describing the machines recommended for your use.

CLARK TRUCTRACTOR

Div. of Clark Equipment Co.

132 Springfield Place, Battle Creek, Mich.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



SOUTH BEND TURRET LATHES

For Rapid Production in the Defense Industries

THIS NEW South Bend 16″ Turret Lathe combines the precision and versatility of a toolroom lathe with the rapid production facilities of a turret lathe.

The power feed ram-type turret has six faces, with automatic indexing and individual stop for each face. The turret is mounted on the inside bed ways and may be clamped at any location the entire length of the bed.

The carriage has friction clutch drive for power cross feeds and power longitudinal feeds, also lead screw and split nut for cutting accurate screw threads. Mounted on the outer bed ways, the saddle wings clear the turret base to allow free movement of the carriage. Telescopic taper attachment, hand lever collet chuck and other attachments can be supplied.

The quick change gear box provides 48 changes for all carriage feeds and turret feeds. In addition, there is provision for changing the direction and speed of the turret feeds with relation to the carriage feeds.

The direct motor drive provides twelve spindle speeds ranging from 21 to 731 R. P. M. Headstock spindle has 1⅜″ capacity for bar stock. Rapid acting hand lever collet takes up to 1″ round stock.

In addition to this turret lathe we manufacture a complete line of back-geared screw cutting lathes, 9″ to 16″ swing, for toolroom and general shop use. Also 9″ and 10″ swing lathes with hand lever bed turret. Write for our catalog on this new lathe and the name of our nearest dealer.

TRADE MARK SOUTH TWINS BEND ENGINE LATHES

SOUTH BEND LATHE WORKS

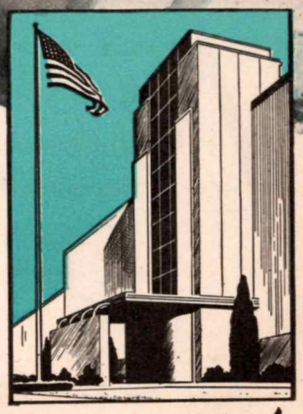
Lathe Builders For 35 Years

814 East Madison Street **South Bend, Indiana, U. S. A.**

LET'S GO! U.S.A. KEEP 'EM FLYING!

FROM PLAIN TO PLANES IN 120 DAYS

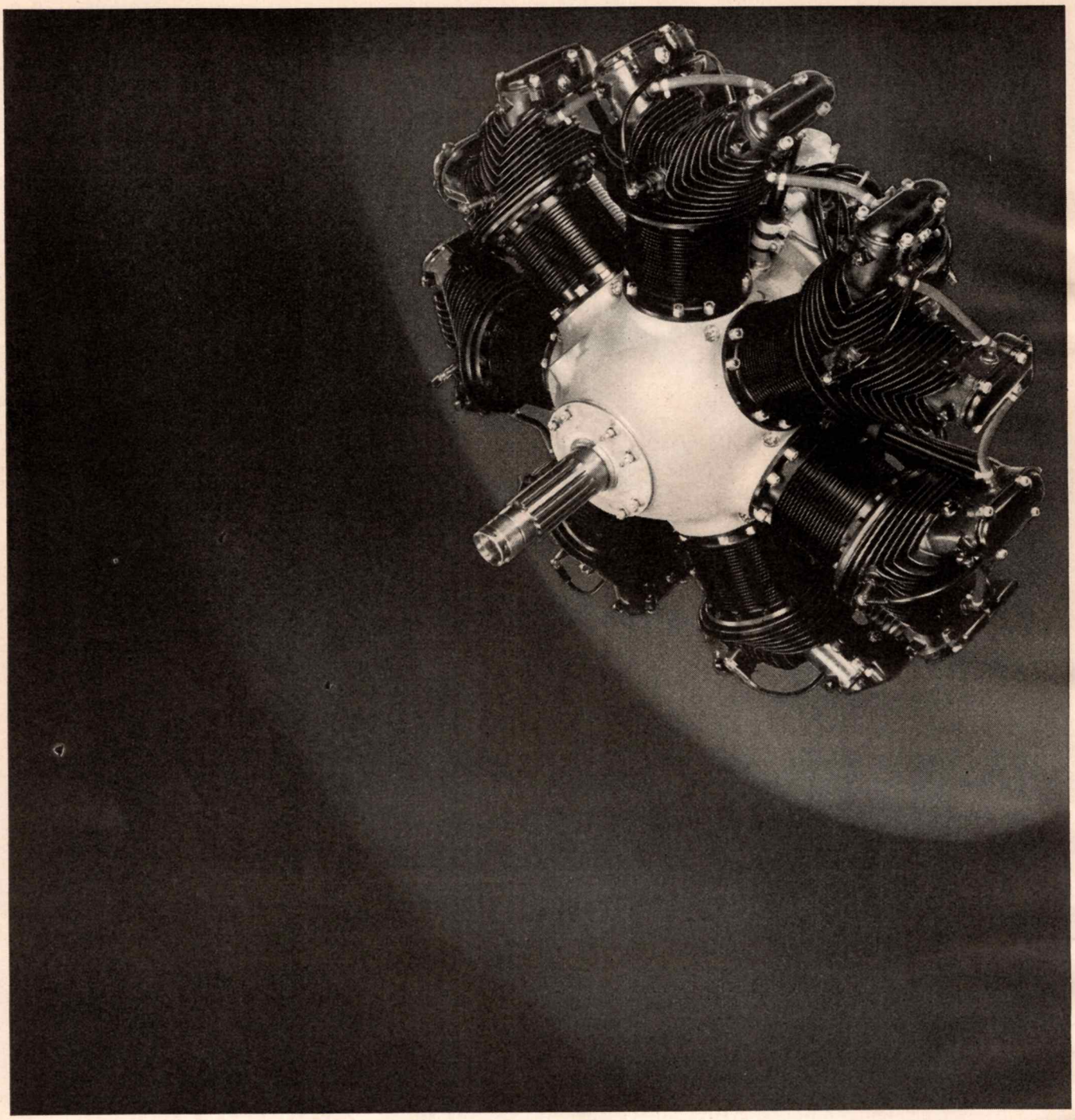
What had been a Texas plain 12 miles west of Dallas is now America's first windowless, air-conditioned airplane factory: 25 acres under one roof. It was completed and planes were being delivered to the U. S. Army Air Forces 120 days after construction began. Within three months the new plant had produced twice the number of planes originally scheduled. Fulfilling defense requirements for decentralization of industry, the Dallas achievement is a tribute to industrial teamwork supported by enthusiastic community cooperation.



NORTH AMERICAN AVIATION, INC.

Dallas ☆ INGLEWOOD, CALIFORNIA ☆ Kansas City

★ ★ TO BUILD WITH TEAMWORK IS *the North American Way* ★ ★ ★



WARNER

AIRCRAFT ENGINES

• 125 H. P. • 145 H. P. • 165 H. P.

WARNER AIRCRAFT CORPORATION • DETROIT, MICHIGAN

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

YO-57

U.S. ARMY AIR CORPS

TAYLORCRAFT YO-57
Official Photograph, U. S. Army Air Corps

"GRASSHOPPERS"—that's the name soldiers dubbed light planes which participated with ground forces in the Army field maneuvers of the past Summer. But, to the Army Air Corps, it's now YO-57s—the official designation for Taylorcrafts recently purchased for further tests as the result of the favorable showing made by the "Grasshopper Squadron".

Under the grueling tests of the Army maneuvers, these planes were required to fly from very small fields and rough terrain in Texas, from cow pastures and roadways in Louisiana, meeting whatever ground conditions existed adjacent to Army Field Headquarters.

Short range reconnaissance and liaison work, carrying messages, and reporting troop movements by means of two way radio equipment are operations for which the suitability of the Taylorcraft YO-57 is being determined.

Purchased "off the shelf" by the Army Air Corps, these YO-57s, except for camouflage finish and very minor additions in equipment, are identical to the Taylorcraft Tandem Trainer being supplied to civilian operators for civilian pilot training and civil defense service.

Your Taylorcraft dealer will gladly demonstrate the superior performance characteristics and show you the modern operating and comfort advantages of Taylorcraft airplanes. See him, today!

WRITE TODAY FOR THIS FREE CATALOG OF TAYLORCRAFT AIRPLANES

Includes full color pictures of the modern Taylorcraft Tandem Trainer, Side-by-Side Trainer, and DeLuxe Airplanes with description, specifications and performance data.

TAYLORCRAFT AVIATION CORPORATION, Dept. 111, ALLIANCE, OHIO

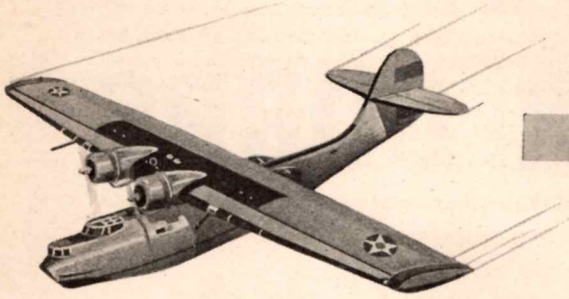
EXPORT: Fairchild Aviation Corp., Jamaica, L. I., New York, U. S. A.

TAYLORCRAFT

DELUXE • SIDE-BY-SIDE TRAINER • TANDEM TRAINER

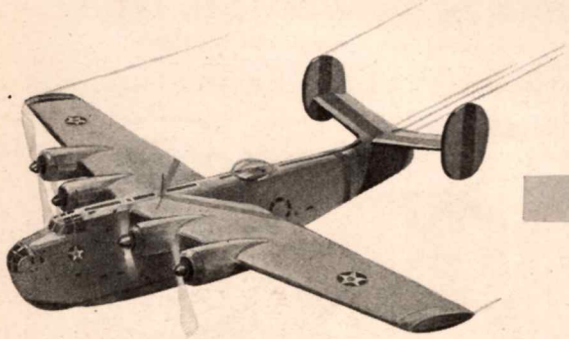
See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

Wings for our way of life!



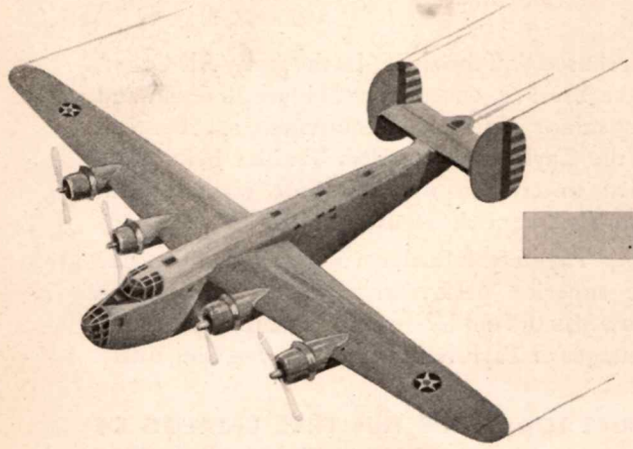
PBY - FLEET AIREYE

- far-ranging vanguard of the world's most powerful Navy.



PB2Y - FLEETSTAR

- shining star in the firmament of the U. S. Navy.



B-24 - LIBERATOR

- hope from the sky for millions now oppressed.

CONSOLIDATED AIRCRAFT

CONSOLIDATED *Aircraft* CORPORATION

ESTABLISHED 1923

SAN DIEGO, CALIFORNIA

LET'S GO! U.S.A. · KEEP 'EM FLYING!

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

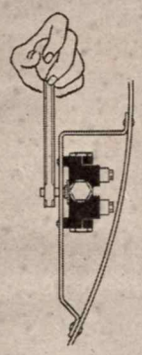
Maximum Performance...Minimum Bulk

There are four important reasons why these radial-type hydraulic selector valves are being ordered and installed in ever-increasing quantities on Air Corps and Navy airplanes.

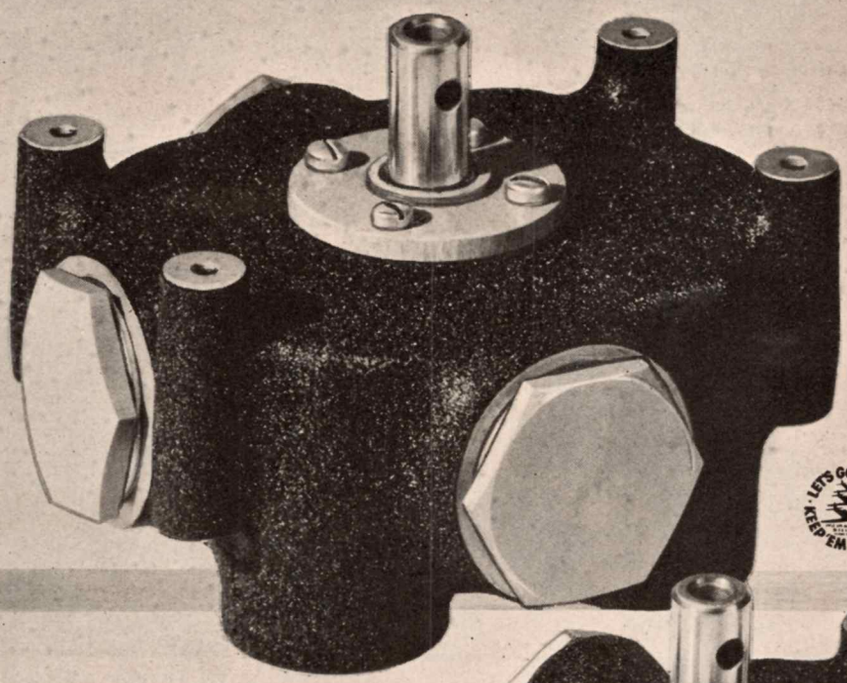
1. Bendix engineers have taken full advantage of the compactness inherent in radial design, giving these valves *maximum performance with minimum bulk and weight.* In addition, these valves are equipped with Bendix-developed plastic poppets weighing only one-sixth as much as comparable steel poppets.
2. Pressure drop is exceptionally low because the design achieves the shortest possible fluid path from inlet to outlet.
3. Operation is smooth and quiet at all flows and the valves have an unusually low handle torque.
4. Simplicity of design and construction make the Bendix valve a true production item. They are being built in quantity under fast precision manufacturing schedules.

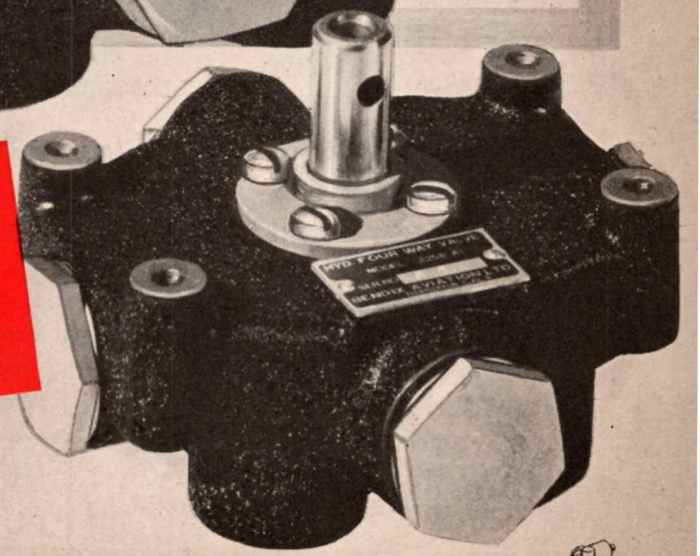
Illustrated are Models 2258-A1 (for ½" tubing) and 2257-A2 (for ¾" tubing). Seven other models are available including dual and triple bank valves and others incorporating integral check and relief valves.

BENDIX AVIATION, LTD.
Subsidiary of *Bendix Aviation Corporation*
NORTH HOLLYWOOD, CALIFORNIA



This typical installation shows how the Bendix Four-Way Valve, because of its radial design, requires a minimum depth in fuselage cross-section





BENDIX
RADIAL FOUR-WAY VALVES

DISCONNECT COUPLINGS **POWER BRAKE VALVES** **CHECK VALVES** **PRESSURE REGULATORS**

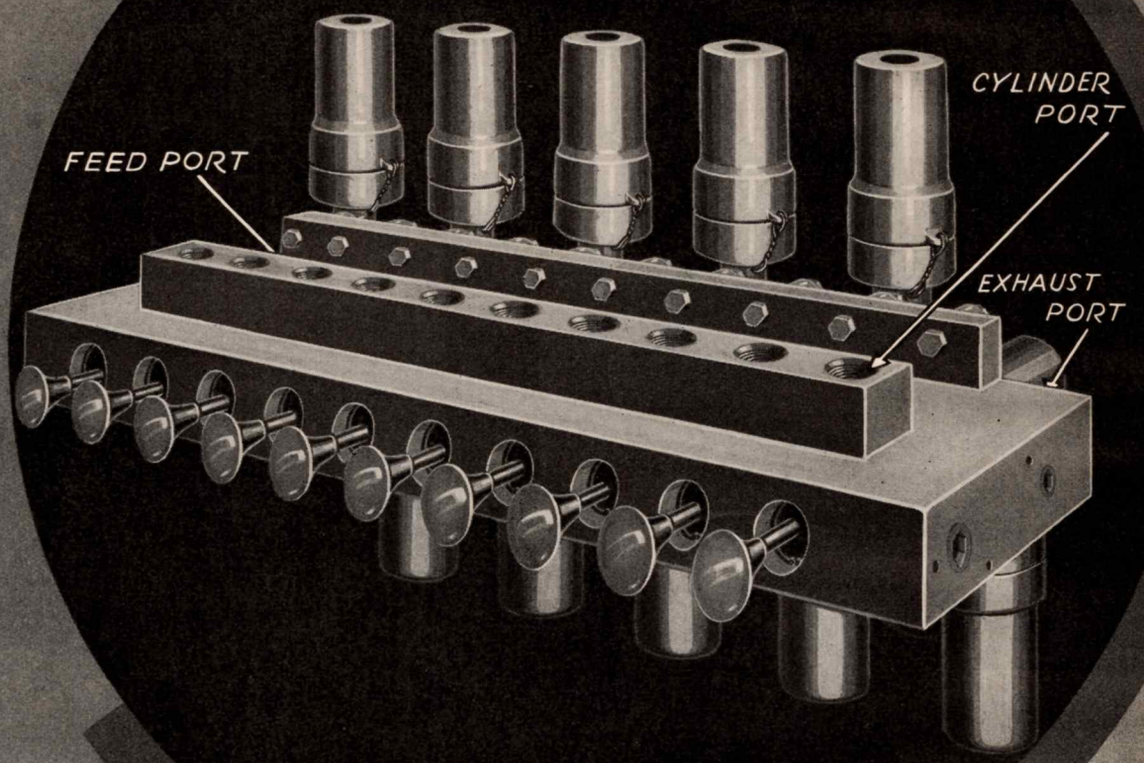
HAND PUMPS **ACTUATING CYLINDERS** **HYDRAULIC ELECTRIC SWITCHES** **RESTRICTOR VALVES**

SEQUENCE VALVES **HYDRAULIC SELECTOR VALVES** **TUBE CLAMPS** **CUSTOM BUILT RADIO**

Announcing

NEW FLEETWINGS GUN-CHARGING HYDRAULIC VALVE

Charges 10 Machine Guns Individually or Simultaneously



LOOK AT THESE FEATURES

- Provides, in a SINGLE unit, means for charging ten machine guns, individually or simultaneously, with an automatic mechanism for returning valve to neutral.
- A simple, one-half inch pull of the proper valve stem will operate the desired cylinder.
- Provision made for operating each unit manually, in case of electrical failure.
- Weighs less than 16 pounds and can be furnished for any number of guns.
- Will operate without seizure from lower than minus 40 degrees F. to above 200 degrees F.
- Valve is practically free from wear, scuffing is entirely eliminated, and seizure is avoided.
- Fully balanced—requires minimum force to operate.
- Design assures extremely easy disassembly and assembly.
- Normal operating pressure can be carried up to 1500 pounds per square inch, test pressures to 4000 pounds per square inch.

Reduces Installation Parts Ordinarily Required by 60%

To the airplane engineer who is eager to build simplicity into fighter airplanes, this new valve, Type B-10-C, should be of real interest. Why? Because it greatly simplifies the task of gun charging, makes this operation faster and more perfect. **It takes the place of ten separate hydraulic valves, and reduces by 60 per cent the amount of tubing, connections, and fittings ordinarily required, and furthermore, reduces original installation time and cost and lowers repair and maintenance expense.**

Our Hydraulics Department will be glad to submit detailed information to you about this new valve, and they'll welcome any inquiry you might have about any of the large line of Fleetwings' hydraulic equipment. Why not write today?

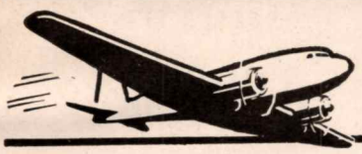
SOON TO BE ANNOUNCED

A new gun-turret valve that operates at a variable speed, enabling a gunner to maintain a continued fire on a moving target. Light in weight, it assures precise, uniform control. If you're interested, write Fleetwings, Inc., Bristol, Penna.

FLEETWINGS

INCORPORATED

BRISTOL · PENNA.



● The Above Recent Aerial View of Spartan School Shows the Following Buildings: (1) Giant Storage Hangar. (2) Administration and Maintenance Hangar. (3) Civilian Administration and A.C.T.D. Flight Offices. (4) New 548x100-foot Mechanics Shop Building. (5) Maintenance Engineering Building, 300x125 feet. (6) Academic Building housing Radio, Meteorology, Instruments, Link Trainer, and Classrooms. (7) Aeronautical Engineering School. (8) Student Study Hall and Accounting Dept. (9) Carpenter Shop. (10) Dormitory. (11) Medical Building. (12) Infirmary. (13) Cafeteria seating 1200 persons, Barber Shop, Soda Fountain and Student Store. (14) Indoor Squash Court. (15 to 22) Dormitories with housing capacity of 850 students.—Other buildings not Shown: Eight-unit Engine Test House, Paint and Dope Shop, Civilian Flight Hangar.

How SPARTAN Can Help You DOUBLE or TRIPLE Your Life Income

● If you are an average high school graduate without specialized training, your earning power in all probability will be limited to $18 or $25 a week, or $40,000 during your lifetime. But if you are ambitious and willing to invest from $200 to $1,000 to prepare yourself for a real career in this expanding aviation industry, you can have an opportunity to *double* or *triple* your lifetime earnings. YOU can have the opportunity to average $36 to $75 a week, and earn $80,000 to $175,000 during your life. SPARTAN training will give you that opportunity.

Year after year SPARTAN has grown because it has equipped young men for successful careers in aviation. It has grown because the aviation industry has demanded more and more SPARTAN graduates. Today it is recognized by the industry's leaders as the outstanding aviation school in the United States.

Here is *two million dollars* worth of opportunity for you, represented by SPARTAN'S new buildings, new equipment, new training planes, new technical courses and other extensive facilities which provide you big advantages, in whatever field of aviation you choose—Sheet Metal, Aircraft or Engine Mechanics, Flight, Engineering, Radio, Instrument Mechanics, Meteorology.

SPARTAN has 38 modern training planes in use by the civil school—6 flying fields—950 employees—the following shops: engine overhaul, airplane overhaul, wood shop, propeller shop, instrument, sheet metal, welding, parachute, engine testing, electrical, radio, paint and dope shop... these laboratories: instrument, meteorology, navigation, fuels and oils, hydraulics and deicing, physics, metallurgy.

SPARTAN'S 100% Approved Repair Station has facilities for servicing 325 planes now used in Civil and Military flight instruction, plus 48 modern engines used for student instruction.

A $750,000 expansion program has made SPARTAN a greater school than ever! . . . the *important school for you!*

New Engine Installation Mechanic and Aircraft Assembly Mechanic Courses

These two new Spartan mechanic courses have been developed with the cooperation of the officials of the Douglas Aircraft Company, and prepare students for work at Tulsa's new bomber assembly plant. The coupon will bring you complete details. Classes start each Monday.

Mail Coupon for Catalog. Next Semester Starts Jan. 5th

SPARTAN

SCHOOL OF AERONAUTICS

DIVISION OF SPARTAN AIRCRAFT COMPANY

Spartan School of Aeronautics—Captain Maxwell W. Balfour, Director
Address Dept. AD-111, Tulsa, Oklahoma

Send me your new Catalog describing in detail the SPARTAN courses I have checked, also stating tuition and living expenses.

*Name*_____ *Age*_____

*Address*_____

*City*_____ *State*_____

*Previous Education*_____ (20)

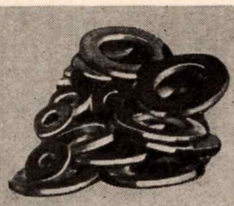
CHECK COURSES YOU PREFER:

- ☐ Commercial Pilot
- ☐ Air Transport Pilot
- ☐ Commercial Flight Instructor
- ☐ Air Transport Engineering
- ☐ Aeronautical Engineering
- ☐ Aircraft or Engine Mechanic
- ☐ Aircraft Sheet Metal
- ☐ Engine Installation Mechanic
- ☐ Aircraft Assembly Mechanic
- ☐ Airline Service Mechanic
- ☐ Radio Maintenance and Operations
- ☐ Private Pilot Course
- ☐ Weather Forecasting
- ☐ Instrument Technician
- ☐ Women's Instrument Technician

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

IN STOCK
FOR IMMEDIATE DELIVERY

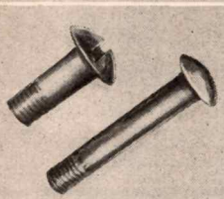
AIRCRAFT BOLTS
7,000,000.



FLAT WASHERS
30,000,000.

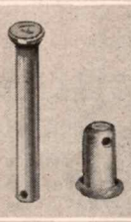
DRILLED HEAD BOLTS
100,000.

LOCK WASHERS
6,000,000.

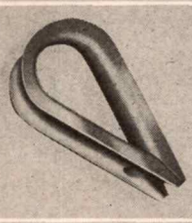


CLEVIS BOLTS
950,000.

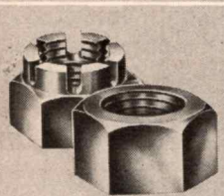
COTTER PINS
8,000,000.



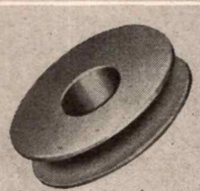
CLEVIS PINS
1,700,000.



THIMBLES
325,000.



AIRCRAFT NUTS
5,000,000.



CABLE BUSHINGS
200,000.

DRILLED HEAD SCREWS
2,500,000.

SHACKLES
85,000.

MACHINE SCREWS
4,000,000.

THREADED TAPER PINS
100,000.

BENDIX **AIR ASSOCIATES, INC.** NEW JERSEY
INCORPORATED

Branch Plants at LOS ANGELES, CALIF., CHICAGO, ILL., DALLAS, TEXAS

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

Easter! Easter! Easter!

Easter!

● Today's big need is for speed in designing—speed in production! That's why practically all major aircraft companies use Bruning BW (black line) prints instead of blueprints.

Easter!

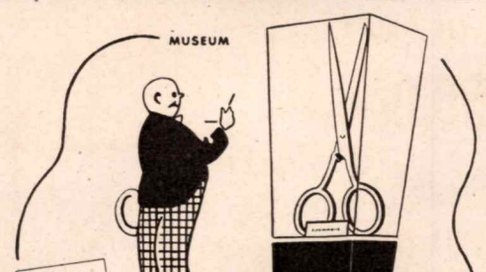
● It takes minutes to make a blueprint—but Bruning BW prints are produced in seconds. It takes five steps to make a blueprint—but Bruning BW prints are produced in two simple steps: exposure and development.

Easter!

● Blueprints need washing and drying before they're ready for use. Bruning Black and White Prints save precious minutes because they need no washing, and because they are dry an instant after they are produced.

Easter!

● The BW process gives you big volume, high speed print production with a single operator. Blueprint processes of comparable speed and volume require at least three operators.

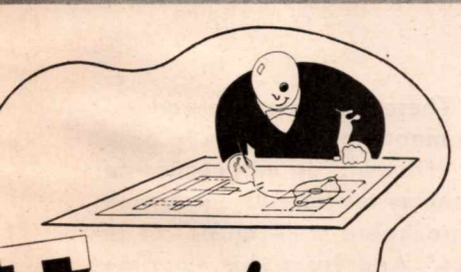


Easter!

● Besides wasting paper and being expensive, trimming blueprints to size is a time-wasting process. The BW process gives you big volume production of sheets *cut to the exact size of your tracings!*

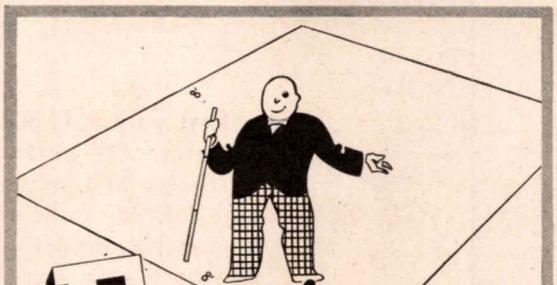
Easter!

● Bruning BW prints are read more easily and quickly than blueprints. That's because BW prints have clear, sharp, black lines on white backgrounds—no fuzzy, hazy outlines to cause confusion and mistakes.



Easter!

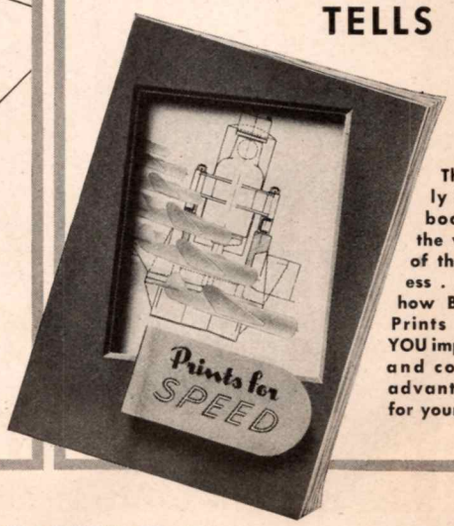
● Because of their white backgrounds, Bruning BW prints are quicker, easier to check than blueprints. No lost notations—no costly mistakes because notes on prints are overlooked.



Easter!

● A compact print department conserves space, time and motion. With the BW process, you can have a complete, big-volume print department in 8'x8' space, without tanks, driers or plumbing connections!

THIS FREE BOOKLET TELLS ALL!



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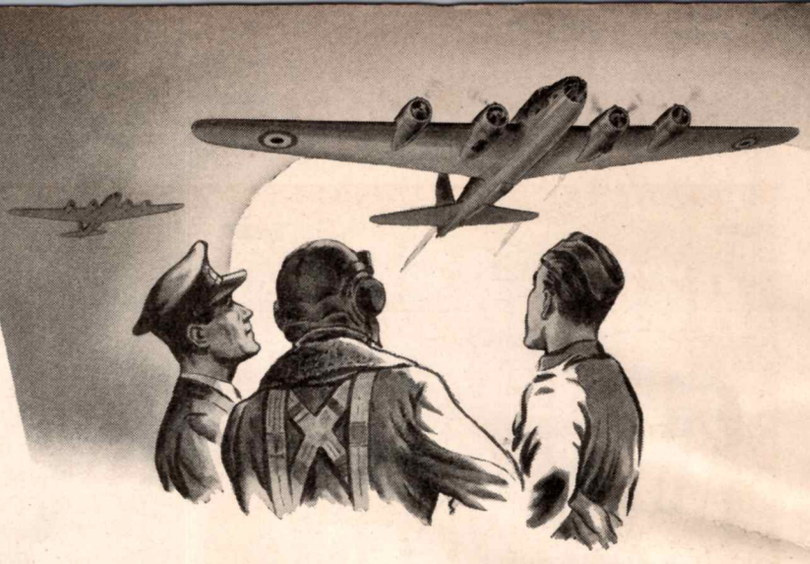

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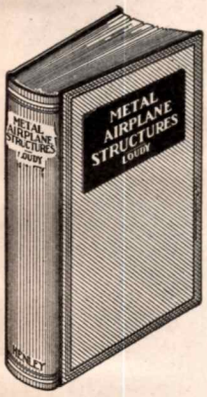

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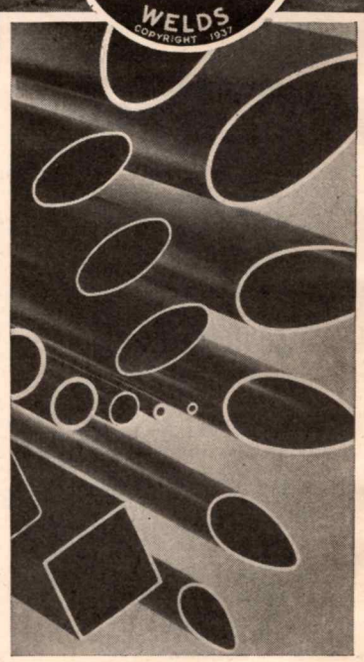

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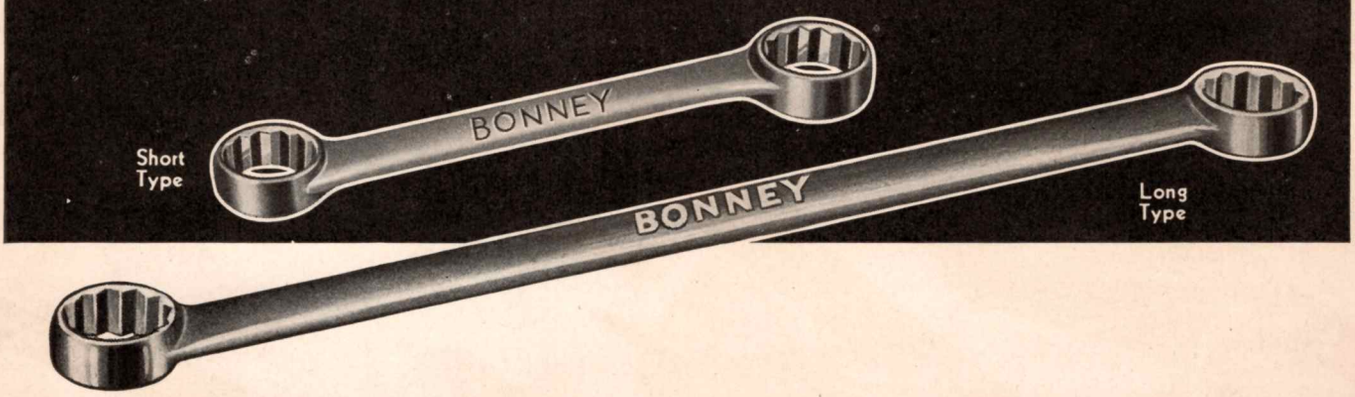

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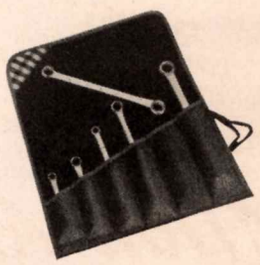

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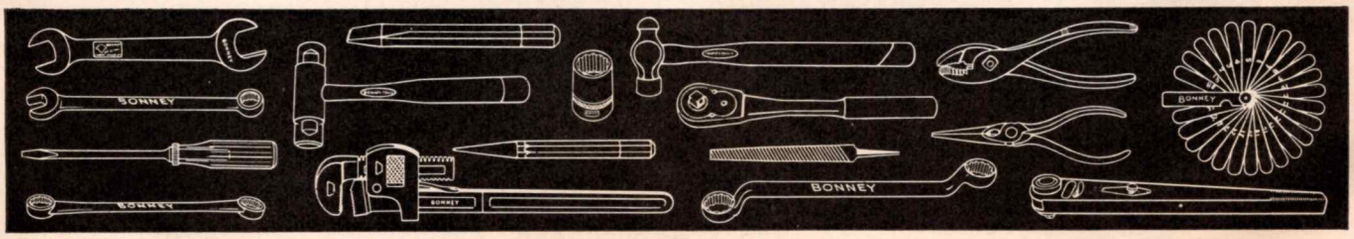

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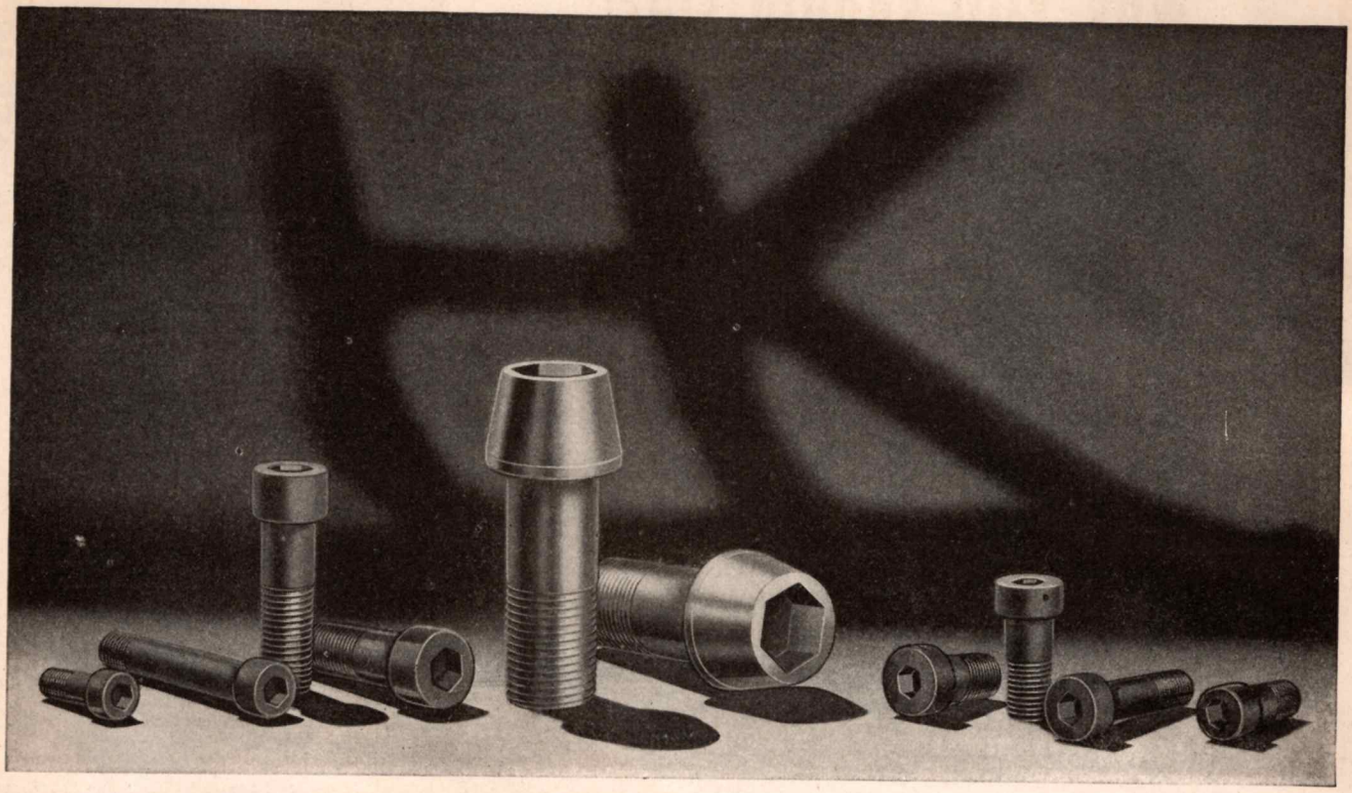

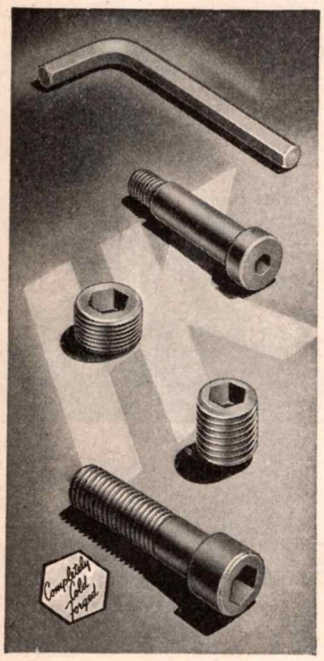

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Editorials

"It is of vital importance that civil aviation be allowed to function independently in the United States throughout the emergency. All over the world civil aviation has been absorbed by the military but this should not happen here. Our civil aviation services are a great national asset, and up to now—and I hope it will continue—the Army and Navy have seen fit to use them but not to disturb them."

—BRIG.-GEN. DONALD H. CONNOLLY,
Civil Aeronautics Administrator

Serious Shortage of Mechanics Threatened

Even if the waiting-for-war period does not burst into a shooting war, there will be a shortage of more than 50,000 mechanics by the summer of 1942. If we go to war the mechanic shortage in the factories and on the flying fields will be anybody's guess, and even half a million is not a wild estimate.

Probably the greatest curse put on a sound mechanic expansion program was allotting $100,000,000 to the U. S. Office of Education for providing free vocational training in the public schools. But money alone, even huge amounts, does not automatically provide a solution. The Office of Education has begun to inaugurate its program; it will produce mechanics, in the course of time. So will the WPA, the NYA and the CCC, all of which are putting in mechanics courses. But all are trying to get equipment, trying to find the experienced instructors, and struggling to get started. In a year or so all of them undoubtedly will be turning out mechanics—good, bad and indifferent—by the tens of thousands.

However, the need for mechanics happens to be immediate, in addition to next year or the year after next when the products of these Federal agencies finally swing into action. Right now we have scores of experienced civilian flying schools and mechanics schools, with the personnel and the equipment necessary to train students. Most of today's experienced mechanics are the products of those schools, or of the Army or Navy.

The Air Force already has realized the advantage of using the private aviation mechanics' schools, and 3700 enlisted men are now getting the type of instruction as can only be given by privately-financed, long established, well organized and soundly operated institutions. Yet, thousands of additional youths could be graduated both from these private schools and from those others that are not being utilized and in which classrooms mostly are vacant. The young men who should be in them are waiting to attend the free government schools — that is when those schools get going and get their equipment and instructors. It brings back not-so-fond memories of another great government idea, the $700 airplane, that never did get turned out.

The "Free Training" Idea

But the idea persisted long enough to ruin the sales of many commercial planes already in production. So today the idea of free training in the WPA or the NYA or the CCC wreaks havoc on the commercial schools, while still not producing the needed mechanics.

Senator Pat McCarran and Representative Jennings Randolph are coauthoring a bill, already introduced in the House, to amend the Civil Pilot Training Act of 1939 by authorizing the CAA to train mechanics. As the CAA has trained its pilots in civilian schools with exemplary success, it undoubtedly will achieve the same good results with mechanics. After all, no one is better qualified to train mechanics than the schools that have been doing it for years. The idea is so obviously sensible and sound that it may have some difficulty in gaining the approval of some of our legislators.

The Problem of The "No Shows"

The airline operators call them "no shows." They're the prospective passengers who reserve seats on a plane, yet aren't on hand when the limousine leaves for the airport, don't cancel their reservations, and don't show up at all. There are instances where people have made reservations on three different trips in three different names in order to have one seat available to suit their convenience.

Under such circumstances the airlines may have refused additional reservations on flights that were supposedly sold out, only to have those flights depart with several empty seats because thoughtless or selfish passengers who held reservations failed to use them and neglected to cancel them in time for the seats to be sold to others. Last-minute cancellations, incidentally, while they may salve the conscience of the "no show," seldom result in a sale of those seats; for passengers do not normally hang around an airport wistfully hoping that some reserved seat will not be filled. They book a seat on a later flight, or go by train. The seat reserved for the "no show" usually is a total loss.

Valuable Time Wasted

The loss of revenue to the airlines is not the only loss. Those vacant seats might have been wanted for some key men in industry or government, by technicians rushing to an emergency job. The priceless element of time has been lost; it has been hogged by someone who wasted it.

National cooperative airline advertising begs patrons not to be a "no show." "The *minute* you know you can't make your plane," it pleads, "please cancel your reservation so that someone waiting may have your seat." Considerate but thoughtless patrons will see the error of their ways and correct them. Others, to the end, will remain "no shows."

The end, we surmise, is fairly obvious. It will be a system of priorities on airline travel, as there are priori-

(Continued on page 151)

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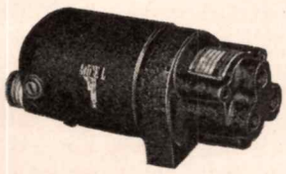

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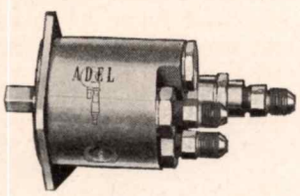

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● Swiftly moving events in the Pacific area, and in the old Western world of the Atlantic, appear to be bringing out the leadership in our Government. There are signs that strong men are rising out of the long ferment in the Capital. Whatever one may think about the President's capacities, there is scarcely ever any debate about the fact that he has strength.

The past two or three months have revealed that there are other strong men in his immediate organization who, probably, have pushed into power despite him. These human forces appear to be chiefly located in SPAB—Supply Priorities and Allocation Board—whose members are Wallace, Henderson, Hillman, Knudsen, Hopkins, Stimson and Knox. Nelson has no vote, but executes its orders. Nelson has strength, but likes to cloak his inflexibility in smooth words. Wallace is another inflexible force all wrapped up in shining precepts and lofty ideals. Henderson constantly works at his job of being a Strong Man, and you cannot fail to realize that he has force. Hillman is strong, within his limits. Knox is tough and blunt and useful; Stimson is bitter and brittle and hard; Knudsen has force that has never really been put into complete play; and Hopkins is the messenger, the ultra-private line into the White House.

This group has put the ruthless toughness into the business of running this War that is necessary, but which will be dangerously unpopular, and which might have been avoided if FDR had put more definition and direction into it months ago. In effect it appears at this writing this group may become a sort of War Regency. It may be their job to direct the wasteful exuberance of the President into the necessary channels of accomplishment. The White House may do the talking and SPAB may do the doing. Apparently SPAB intends to take the initiative even from Congress. In clamping down on all heavy industries, including rivers, harbors, flood control, public buildings, power projects, reclamation, it gave orders to Congress. And Congress took it meekly and liked it.

In the most recent organization chart (they issue charts here every fortnight) you need a microscope to find SPAB. It is approximately a War chart. There is everything on it except the normal Government machinery. It has 24 major parts besides SPAB. Under these major parts are grouped at least 75, probably 100, subordinate units. There are not less than 30 major press agents, at least one attached to each major agency; and each major press agent has a number of assistants. This propaganda corps has been assembled chiefly from among the newspapermen who are friendly with the White House. We have no censorship, but vast fields of public activities are closed to the channels through which the public gets its information. It is this strangulation that causes much guessing and misinformation.

Latest official reports credit the industry with producing 1914 military airplanes in September. Those in the responsible know in OPM make no bones about suggesting that this is just 600 to 1000 short of the number which should have been delivered that month. They do not blame the industry. They blame the Government. Despite SPAB and its potentialities, they tell you the industry was checked in its efforts to deliver because it could neither get an adequate supply of raw materials nor parts nor help.

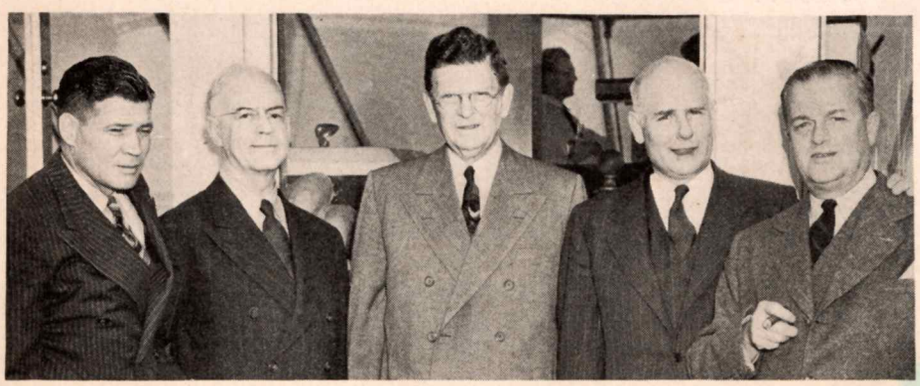
They make no secret of the fact that for many weeks 100 twin-engine bombers were waiting delivery from the Martin plant because there were no propellers. And we are told that 245 *Airacobras* were held up for delivery at Buffalo because they had neither propellers nor machine guns. There was a time when Boeing could not finish bombers for lack of aluminum and other vital materials; and there were tangles in priority ratings that made the allocations almost meaningless.

The conflicts within the defense organization over authority still goes on. Those who have business with Government for materials and supplies still spend weeks running around for answers to their puzzles. Many hundreds handling some part of defense business come here and seek answers they cannot find. There are those inside the defense organization who say the officials who could cure the trouble act somewhat like the physicians who administer to a patient with pneumonia, they let it get worse to make it get better.

Theoretically, at present, all the 100 defense units head up to White House for final orders. And by the same theory most of the answers are assumed eventu ally to come via Donald Nelson. Amazingly candid and action-insistent Nelson does NOT expect to last long. The impression is that the White House, in self-defense against the growing muddle, will be obliged to make the huge and heavy-handed Henderson the Defense Czar. You gather the impression that Henderson's own subordinates expect that to happen. Incidentally it may tell you something to learn that the academic gentlemen and ladies in the Henderson set-up are credited with receiving about 60% to 65% more pay than the people who labor in other defense agencies.

SPAB has Ok'd the program for construction of 228 commercial transports for the airlines during the next 18 months. The sanction pointed out this constituted well over two-thirds of the present commercial airline transport fleet, and the order specified the planes must be built with approval of the Army. The Army might need more troop carriers, and if the need arises the ships are subject to demand delivery to the Army.

(Continued on page 201)



Mayor E. J. Kelly meets aviation officials at the Washington National Airport. (l-r) J. Groves, mgr. of the airport; Gen. D. H. Connolly (CAA); Mayor Kelly; Robt. E. Hinckley (Dept. of Commerce); Stick Randall (TWA)

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

THE TRUTH BEHIND THE STRIKE SITUATION

CY CALDWELL

● In his Labor Day broadcast President Roosevelt said: "Today the chief American fighters in the battles now raging are those engaged in American industry. No group of Americans has realized more clearly what Nazi domination of the world means than has organized labor. No group has a greater stake in the defeat of Nazism."

If the workmen in American defense industries are regarded as "fighters in the battles now raging" it is only logical to compare their actions with the actions of those fighters bearing arms in the battles. During the past year tens of thousands of these valiant warriors have laid down their arms and retired disgruntled from the battlefield of the factory, to be coaxed back into the fray only by bribes of higher pay. It is as though the United States Navy, ordered to patrol the seas and shoot Axis raiders on sight, should refuse to leave port until they were given a raise.

The War Department has announced that from Jan. 1 to Sept. 1, 24 million man-hours of labor were lost while the valiant industrial defenders of our liberties were clamoring for more pay. If these refugees from the battlefield had been enlisted men in the armed forces of any nation now at war, a certain percentage of them would have been taken out and shot, to encourage the others to return to the fight. In our sentimental nation, however, they are wheedled into the fray again by giving them more money; in plain words, they are bribed back into the battle. There doesn't seem to be any reason why they shouldn't desert again, and again be enticed back to their noble tasks; again desert, and again improve their status. The process, apparently, is unending.

In their monthly digest of business conditions Stevenson, Jordan & Harrison, Inc., Management Engineers, have this to say: "The attitude of organized labor with regard to wage demands, overtime provisions in contracts, and strikes which delay vital defense production, together with some recent decisions of the National Defense Mediation Board and the strange attitude of the Administration relative to these conditions, are having results which are detrimental to the public interests! Among these results are a lowering of army and civilian morale, increased cost of defense production, increased distrust of the Administration's purposes, increased disputes, strikes, and demands for the closed shop and the check-off, and lessening of employee-employer cooperation and effort."

So far as the employer is concerned, pay increases do not, and in the nature of the case cannot come out of his pocket. His pocket is not deep enough. Inevitably, increased manufacturing costs must be passed along to the consumer; and with defense industries the consumer is Uncle Sam, which is the collective name for all of us. Thus strikes in defense industries are in effect strikes against the taxpayers of the United States. And it is noteworthy that in no single instance have these strikes failed; the strikers have won, Uncle Sam has lost.

Worker's Just Complaints

Defense workers have their just complaints. The cost of living, especially in the matter of housing, tends to rise more rapidly in mushrooming industrial areas than it does in the nation at large. Workers forced by a housing shortage to live many miles from their place of employment face increased costs of transportation. However, the labor cost per unit of product rose nearly 16% during the past year, while the cost of living index rose less than 6%. During the past two years average weekly earning of all workers in 25 industries shows an increase of 30%, or nearly a third above 1939.

It is chiefly the hypocricy of politicians, eager to hold the huge labor vote, that leads them to describe workers in defense industry as "fighters in the battles."

Human nature being what it is, strikes may be expected to continue until the Government insists that wage demands and grievances which cannot be settled by employer and employee should be decided by mediation by an impartial Defense Mediation Board. As matters stand today organized labor is permitted by the Administration to use a national emergency to further their own selfish ends. It is coddled and pampered and bribed into service, while other citizens are forced by law to join the Army for $21 a month and board. If Army morale is low, the blame for it must be laid on the doorstep of this labor coddling Administration. What sane young man wants to shoulder a rifle for such humble pay when he can put rivets into a bomber, go on strike whenever he desires, and be referred to by the President as "the Chief American fighter"?

What are the basic reasons for these unending labor disputes? Contributory, not basic, is the natural human desire to get as much as it can; contributory also are the politicians who do not risk losing the big labor vote. Basic, is the racketeering labor leaders, many of them with criminal records, who have never performed an honest day's work in their lives, and never will. Yet, we cannot absolve the Government of its responsibility for assuring a never-ceasing flow of vital defense materials.

One Chief Goal

From its beginnings the New Deal has had one chief goal: to perpetuate itself in power. All else has been made subservient to this one aim. And, not to confuse the issue with talk of Totalitarianism or Dictatorship on the European plan, let us recognize honestly that this is an old American custom, sacred to Party Government.

There are in the United States two main parties, Republican and Democratic, which have contested for the spoils of government; and sometimes one, sometimes the other, has been victorious. The victor is the In party, the vanquished the Out. The Ins are in clover, the Outs are completely out of luck. The moral, therefore, is plain: be an In; Get in, and Stay in—if possible. There have been numerous other parties, supposed to represent this, that, or the other political viewpoint; but as none of them ever managed to get In, they may be classed as the Permanent Outs. For instance, if you always want to vote Out, vote Socialist, Farmer-Labor, Communist, and of recent years, Republican.

And, incidentally, let me remark that I do not share Lindbergh's expressed fear that we will not have another presidential election. We will continue to hold elections, but it is relatively certain that Roosevelt, or

(Continued on page 246)

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

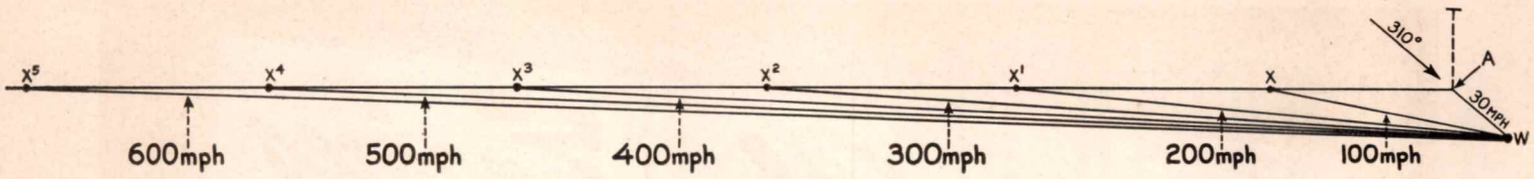


Fig. 1:—Graphical solution showing the effect of a 30 mph wind on six different airplanes with speeds ranging from 100 to 600 mph. Although each plane is traveling in the same direction, the headings are different, changing with the various speeds

WHAT ABOUT DRIFT?

WARREN C. YOUNGCLAUS

Chief Ground School Instructor, No. 3 British Flight Training School
Spartan School of Aeronautics

● The wind element is an important factor in all aerial navigation problems and the success of any pertinent work on a flight depends first of all on the pilot's knowledge of the wind force and its direction during his trip.

As this element plays such an important part, several things must be taken into consideration before the take-off, namely: the wind will change at different altitudes; the wind will change in direction and velocity as various meteorological areas are passed; and the wind data given for a particular altitude may be a few hours old.

Wind data at the numerous weather reporting stations are determined at the surface by instruments which naturally give accurate readings for ground level observations. However, the upper air data must be determined by instrumental observations, the most common method being the use of the pilot balloon. Such observations are taken periodically, and offer a fair perception of the winds at various altitudes. These observations are limited to the levels under the ceiling, for visual contact with the balloon is necessary to obtain the reading. Naturally, the higher the ceiling, the more flight levels it is possible to report. Supplementing the pilot balloon at key stations is the radio-meteograph which, by means of radio waves, transmit impulses to ground equipment for other meteorological data beyond the ceiling and at the higher altitudes.

Foremost medium for wind observations are the reports of pilots on scheduled airline runs, and their numerous reports when compiled have been found to provide extremely valuable wind data. As is generally known, the success of meteorological forecasting depends on the number of reports available to work with.

In applying the wind to determine the necessary navigation data for some flight, the computation is made on the assumption that the wind will affect the course of the plane 100%. In reality, there is a slight slippage, which, for all practical purposes, can be eliminated.

The speed of the aircraft will determine the amount of drift correction necessary to overcome the effect of a wind, for the greater the speed of the aircraft the less will be the necessary wind correction. Thus, referring to fig. 1, it will be seen that for 6 airplanes flying west with a constant 30 mph wind from 310°, the amount of drift correction necessary to make good the desired course will vary according to the speed. The 6 planes in the example have speeds ranging from 100 mph to 600 mph respectively. Therefore, in flying short distances, the higher speed plane will offer less chance of error in this type of navigation work than the slower plane.

Pioneer Instrument Photos

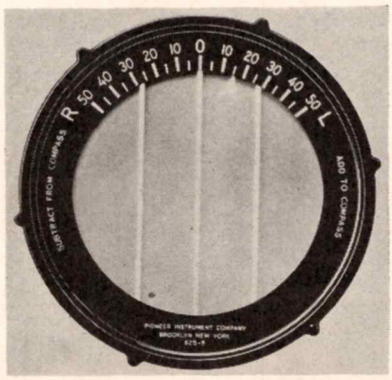


Fig. 2:—Pioneer floor-type drift indicator. To make an observation with this instrument it is only necessary to rotate the glass disc on which are painted slim, parallel lines, to the right or left until ground objects appear to travel along the sight lines. The drift angle is then read directly from the scale. The instrument at the right is the latest version of the floor-type indicator

While each of the airplanes, if no drift correction be made, will at the end of 1 hour of flight, drift off course relatively the same distance, the correction angle to maintain the constant course will vary as shown by the accompanying diagrams.

Thus, if all 6 airplanes were to fly to a common point 100 miles from a base, the higher speed ships will hardly be concerned with the comparatively strong 30 mph wind, while the slow ships will most certainly have to account for the wind.

Several good methods have been devised whereby a pilot in flight can determine the wind force and direction at some determined altitude. Of these, the Double Drift method is perhaps the most accurate, but it has the disadvantage in that the use of a drift indicator is necessary. The drift indicator, while usually not standard equipment on the average ship, is really an integral piece of navigation equipment and its use should not be underestimated .

Simple in construction, the instrument is nothing more than a rotating glass disc on which are drawn parallel lines, along which objects sighted on the ground can be made to pass by merely turning the disc to one side or another. Fig. 2 is a common type of indicator and shows the simplicity of construction. This type is placed on the floor of the cabin, over a transparent opening so that ground objects can be seen beneath the plane.

The various types of airplanes now

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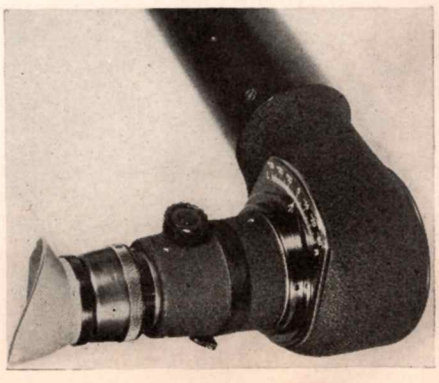

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

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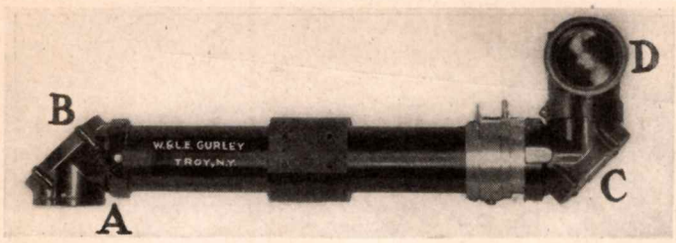

Fig. 3:—(left) Gatty drift indicator type used for short horizontal installations. Adapted to planes of such design that installation does not allow floor type. Ground objects directly beneath A are reflected by mirror B through bakelite tube to mirror C, to eyepiece D

(Continued from preceding page)

using the drift indicator has made it necessary to design several different instruments which would be better adapted to installation under varying conditions.

Fig. 3 shows a design which is fitted to the airplane in such a manner that the navigator sighting through the eye-piece, D, can see objects directly beneath the opening, A. The tube is installed in the side of the airplane and can be made of sufficient length to clear all obstacles, giving an unobstructed view of the ground below. This type is suitable for use in amphibians and seaplanes where it is not possible to sight directly through the flooring.

For installation in cabin planes where sighting through the floor is possible, the design shown in fig. 5 is used. Basically, however, both instruments are the same, the difference being only in the shape of the extension sighting tube. Fig. 6 shows the heart of this instrument. Comparison with this to the now obsolete type shown in fig. 2 will show how the same principle prevails. The newer designs are improved in appearance rather than principle.

Other designed instruments embodying improved features are being developed for use under present war-time conditions. The delicate mechanisms of bombsights include refined drift indicators without which the bombardiers would be at a tremendous disadvantage. Exact knowledge of the wind force and direction, the ground speed and other navigational factors found by use of the drift indicator, is a necessity.

Equipping the rear gunner, located in the tail of the larger ships, with a drift indicator makes it possible to check on landmarks out of range of the forward sight. This is useful especially when flying over water and using smoke flares. Some tail drift meters have special attachments which make it possible to change the field of vision from sighting directly beneath the sighting tube, to some distance ahead and behind the plane by shifting the reflector glass.

In using the drift meter for taking sights to work the wind force and direction by Double Drift, readings are taken on two courses 90° apart and the drift on each course, or leg, is noted. From this reading the data can be quickly computed either graphically or by computor, the latter being the quicker and more logical method.

An alternative method and one which

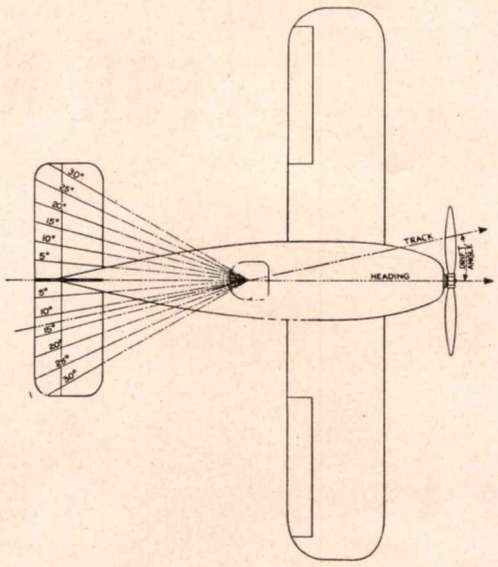

Fig. 4:—Above drawing shows sight lines on horizontal stabilizer. Glancing back, the pilot gets close approximation on drift. These lines are not always necessary; most pilots can get fairly accurate results after little practice on judging drift by sighting over side of fuselage

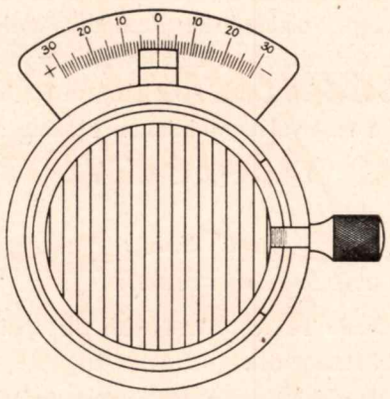

Fig. 6:—Heart of Gatty drift indicator. Note standard sight wires and scale. Instrument is operated in same manner as floor type instrument

is more commonly used because the use of a drift indicator is unnecessary, is the True Heading-True Course method. A pilot flying between two points can determine the true course by measuring from his map, and the time interval between the points will give the ground speed being made good; on the other hand, the compass will give the heading which it is necessary for him to steer to make good the above true course, and, by correcting this compass heading for variation and deviation, the true heading will be determined. The air speed can be read directly. Thus, knowing the true course, ground speed, true heading and true air speed, the determination of the wind force and direction can be accurately computed.

It was the practice some years ago for pilots to lay off drift lines on the elevators and stabilizer so that when in flight, it was only necessary to glance back and momentarily note the angle between the course and heading to determine the drift (fig. 4).

The wind will always have to be accounted for, and with little practice, the average pilot can in time become quite proficient in making drift approximations.

Installation of the drift indicator requires that the sighting wires, when the scale is set to zero, are parallel with the longitudinal axis of the airplane. To take a drift sight with the instrument it is only necessary to choose a prominent landmark over which the airplane is passing, noting the angle which the object makes with the path of the plane as it passes over the point. The following example is given to clarify the operation.

Assume a day on which there is no wind, for all practical purposes a "dead calm." If the airplane is making good a track between two points, A and B, then the heading of the plane will coincide with the track, there being no wind element for which to correct. If an object beneath the plane is chosen as a

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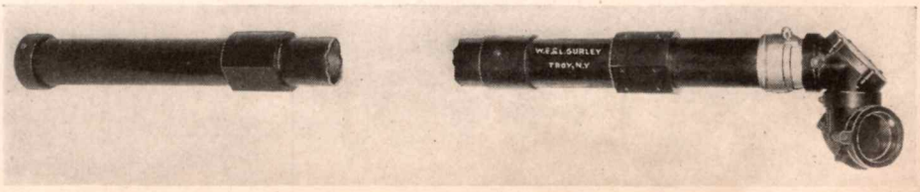
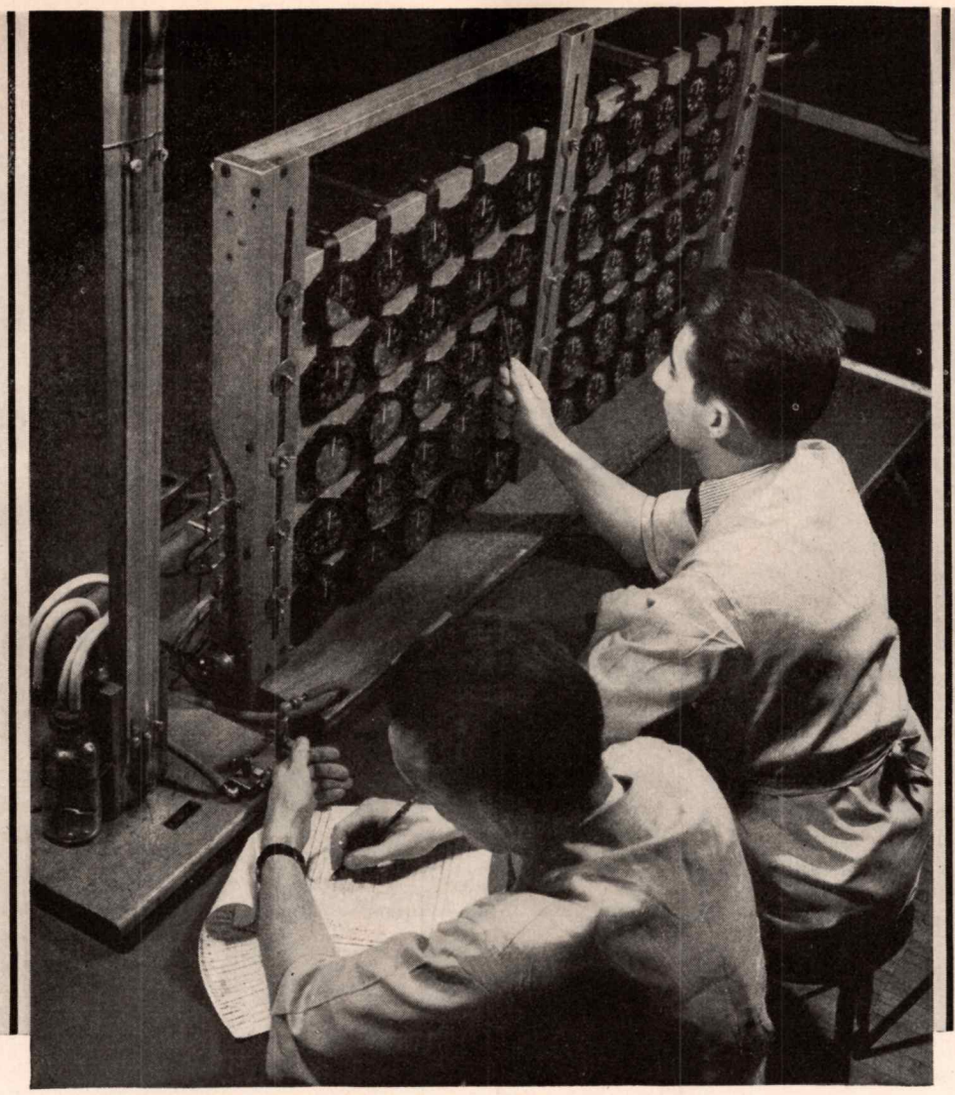


Fig. 5:—Drift indicator for vertical installation. This instrument works on same principle as horizontal type; objective end is installed flush with flooring, to eliminate drag

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



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LET'S GO! U.S.A. · KEEP 'EM FLYING!

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

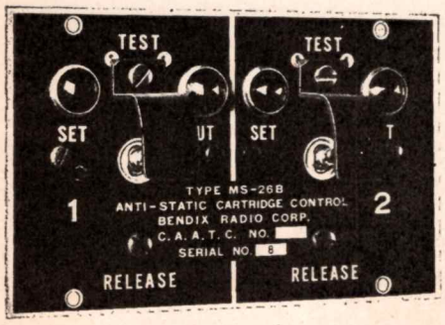
PRECIPITATION STATIC

DAVID S. LITTLE

● Shortly after the first installation of radio receiver apparatus on aircraft and during the early days of radio and instrument flying an interference to radio reception was noted. For lack of a better name, it was promptly dubbed "rain static," a quite descriptive and appropriate name at the time for the interference was first noted while flying through moderate and heavy rain. Shortly thereafter, however, this same type of interference was noted in snow and still later under conditions where no actual precipitation existed. The phenomena caused the radio experts to ponder.

Realizing the probable limitations of radio under such circumstances and appreciating the potentialities of the future might be considerably retarded in development if this condition were accepted as inherent to bad weather operations the radio technicians went to work on this "needle in a haystack" problem. They have been aggressively pursuing it ever since. Much has happened in the intervening 12 or 13 years and with the arrival of winter weather with its much too frequent precipitation static it may be advisable at this time to review aviation radio's unfinished problem.

At the time this interference was first noticed the open cockpit, single engined mail planes then in service carried only a radio-range-weather receiver. These receivers, tuning over the low frequency band of 200-410 kcs, were designed to operate on the extremely small antenna it was then practicable to carry on those aircraft. Consequently, the receivers were much more sensitive than receivers of that day were averaging. It was the custom in those earlier days to have a vertical mast antenna of about 4 to 6 ft in overall height rise just back of the cockpit on top of the fuselage. The receiver was mounted as close to its base as practicable. Earliest of these mast antenna were fashioned from insulated streamlined tubing or a wood strut having a routed center into which a length of insulated wire was laid.



Static suppressor control panel showing tell-lights and switches

Dual static cartridge installation in tail cone of a Douglas DC-3

First reports on "rain static" were made by users of metallic tubing masts, which occasioned a first conclusion that rain droplets were charged and upon striking the bare antenna mast (with its especially "sensitive" receiver) discharged to ground through the antenna-receiver circuit and thus caused the bothersome noise. Such exposed metal masts were promptly covered, tape and dope being used plentifully as assurance against water striking the bare antenna. As pilots became accustomed to using radioranges and gradually pushed further into bad weather on instruments, the reports of "rain static" became proportionately more numerous. Then it was learned that making the mast antenna weatherproof did little good toward reducing the rain static difficulties.

The first reports on rain static described it as sounding in the earphones as though someone was "dropping dried peas on a tin roof." Later reports indicated that in more severe conditions this noise increased in intensity and sometimes simultaneously higher in frequency until in some instances the tone passed through the entire audible frequency spectrum. Still later reports were to the effect that occasionally the receiver went completely dead after an instance where the "static" had run the gamut of audible frequencies. As increasingly worse flying weather was tackled by pilots rapidly learning the ways of instrument flight, reports of complete receiver failures became far too frequent. These reports usually indicated that the receivers were dead only while passing through certain weather conditions. Certain routes having somewhat distinctive weather conditions suffered more than others. Route operators compared notes. Finally, Transcontinental & Western Air and United Air Lines, basing their action on certain marine findings and practice, decided to experiment with an electrostatically shielded loop antenna. The antenna proved promising, and its usage spread. While each user found certain differences of pilot reports, all reported that the shielded loop greatly reduced "rain static" worries.

As an obvious by-product of this antenna, radiocompass operation spread rapidly as a secondary method of navigation, somewhat a supplement to radiorange flying, by the simple device of rotating the shielded loop.

In the course of this cut and dry engineering, new and faster aircraft came into use; cruising speeds jumped from 100-125 mph to 150-180 mph. As cruising speeds increased, it was noted that "rain static" increased. Apparently speed of movement had a bearing on this bothersome condition. Also, it was learned by comparison of reports that such shielded loop antenna did not always do all that was desired—during sand storms and warm rains they did not appear to serve much purpose, although during dry snow or ice storms where temperatures were low, they seemed to work perfectly.

Apparently temperature of air as well as speed had something to do with the situation.

Demand Upon Radio Engineers

With increasing passenger traffic, the need for greater safety and reliability of instrument flying schedules placed a heavy demand upon radio engineers to clean up still further this then unexplainable interference to reception of radiorange signals.

Finally, United Air Lines, enlisting the interest and co-operation of Reed College, Purdue University, Oregon State College, Bendix Radio Corp. and Bell Telephone Laboratories, decided to give this problem concentrated and serious study. A winter was spent flying an air-

(Continued on following page)

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

The Birdmen's Perch

The editor's chair is a hot seat! Never before in the long career of "The Perch" have we received such scathing letters as have lately been written on the subject of "harder problems." The customers say we are sissys. They say the problems aren't *half* tough enough. And to make their point clearer, they send in problems that really are tough. Can you top this month's? Send 'em in, fellows . . . the more the merrier!

Major Al Williams, alias, "Tattered Wing Tips,"
Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh, Pa.

DEPT. OF INFORMATION

We suggest you cut out the following and paste it in your helmet. It is contributed by Walter A. Biddle, Ground Instructor at Cutter-Carr Flying Service, Albuquerque, New Mexico. Them's words of wisdom, Mr. Biddle!

DON'T EARN YOUR WINGS
Get A Fitted Pair Free From St. Peter

Always take off with a cold motor, you waste so much gas warming the engine.
Don't fasten the safety belt, that's for sissys.
Don't look for other planes in the air, they will miss you most of the time anyway.
Practice your steep turns over the girl-friend's house; she will think you are the cutest corpse.
Always fly into a thunderstorm, it must be interesting for few ever come back after they go into one.
Stretch your glides to the last inch, if you don't reach the spot you will make a nice one anyway.
Your gas gage is always correct, only *old* pilots look in the tank to check.
Pull the nose very high in slips, it gives the ground observers a bad case of the jitters.
When approaching a strange field, sneak in low and straight, it is such a surprise to the local flyers.
When a plane is placarded for a maximum speed, see if you can't squeeze a few more miles out of the old crate.

Don't have your parachute packed every 60 days, that's just a racket thought up by the chute packers.
When taking your girl for her first ride, pull a forced landing; the motor usually catches and what if it doesn't.

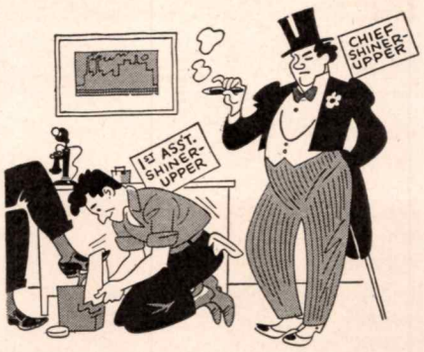
THIS MONTH'S BRAIN TWISTER

Well, here's one of the fellows who thinks the problems should be much tougher. This one is from a Pvt. (Sgt., by now, we hope) at Selfridge Field. Send in your answers, guys, and send in a tougher one if you can!

The pilot of a plane flying North began a turn over an East-West highway maintaining the same bank and altitude throughout a 360° turn. There is an East wind blowing at 30 m.p.h. When the pilot had completed the turn he noticed that he was 500 feet further West along the road. If the speed of the plane was 180 m.p.h. what was the radius of the turn?

WE DO IT UP *EXTRA* GOOD!

Once upon a time we had a shoeshine man here in the office. Not just an ordinary shoeshine man, either—this fellow was very superior. He carried an assistant with him who first shined the shoes. Then our superior boot-black *shined the shine*. Yes, the result was wonderful.



We tell you this because here at Gulf we practice just about the same trick in refining Gulfpride. We *shine the shine*. In other words, we give Gulfpride an extra something with a special refining method of ours—the Alchlor Process. Because we started with the finest crudes, and because this Alchlor Process takes out *more* of the carbon-and-sludge-makers, the results are wonderful—just like the shoe shine.

Ask the next pilot you meet, how Gulfpride has acted in his plane. He'll tell you it's the finest protection an airplane engine could ever get!

THIS MONTH'S WHOPPER

Dear Major:

Being of a rather conservative nature I was loath to discount some of your stories on the merits of G.A.G. To we flyers up here in the bush that liquified dynamite is something we hear a lot about but cannot purchase.

One day last summer we were diamond-drilling a claim on one of Ontario's many land-locked lakes. Our Waco supply ship was a day or two overdue with our supply of gas for the drill motor. Towards evening, however, an American who was touring around in search of some exclusive fishing chanced to drop down on the lake we were operating from. As our gas supply had run out and the drill stopped operating I went down to the shore and started a conversation. When I told him what our situation was he immediately offered us a few gallons of his fuel supply to use until our plane arrived. Up to this time let me add that I had not taken seriously the claims for your "stormy petrol."

Well, we filled up the tank of our drill motor with the few gallons we had borrowed. When I spun the crank, something seemed to snap and the four-cylinder power plant started to whine like a Wright Cyclone on a test block. We were helpless, the only thing to be done was to let her run out.

Now this may sound hard to belive, but in the morning when the commotion had stopped we ventured back to the scene and found a very tired-looking drill assembly relaxing beside a perfectly cut shaft 500 ft. deep and the conventional width. When the stopping crew flew in later and I explained it to them they told me to tell it to the marines. Well, I'm going them one better and telling it to you.

A northern flyer,
Syd. Dunkley
88 Cedar Street,
Sudbury, Canada

Gulf Oil Corporation and Gulf Refining Company . . . makers of

GULF **GULF AVIATION PRODUCTS**

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

(Continued from preceding page)

line aircraft in all areas of rain static. The ship was especially equipped and manned to check the many theories then existing on this phenomenon.

The study revealed that this condition while attendant usually to some of the several forms of precipitation or cloud moisture was due not to rain droplets or snow particles striking the ship's antenna but instead to an extremely large voltage gradient existing in the atmosphere brought about by certain meteorological conditions existing in certain areas—that when an aircraft passed through such an area it became highly charged with circulating currents of considerable magnitude. As this charge leaked off, the either visible or invisible discharge of it from the many sharp points of construction of the ship caused the so-called "rain static" just as any highly damped electrical discharge in the vicinity of a sensitive receiver sets up interfering electrical noises within that receiver. Space here does not permit a detailed coverage of this important work, but the full story of this scientific expedition which did so much to unravel this far too old mystery was told by H. M. Hucke, then of United Air Lines, in the May, 1939 issue of the Proceedings of the Institute of Radio Engineers. It is well worth reading.

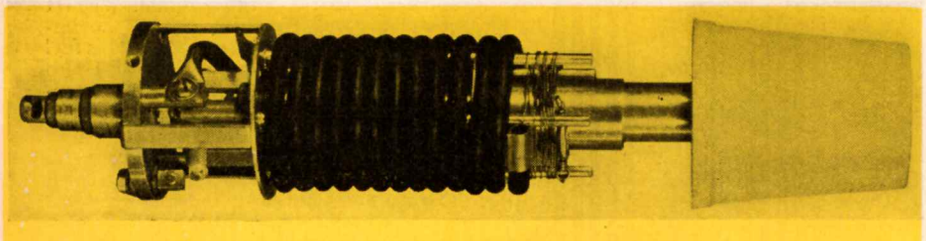
Once the basic natural cause of precipitation static had thus been determined, a supplement to the loop antenna soon followed. It may now be an obvious conclusion that a simple way to eliminate the trouble would be to create a discharge point sufficiently smaller than any discharge point on the aircraft and at a distance to the rear of the ship such that any accumulated charge would be drained off at only the one point; also that interference from that single discharge be prevented from returning to the aircraft structure. Hucke gives R. H. George of Purdue University credit for the suggestion which resulted in Bendix Radio designing and building a fine wire and suppressor system of plane discharge now widely used on airline aircraft and referred to as an Anti-Static Suppressor Cartridge.

Practical Product Now Used

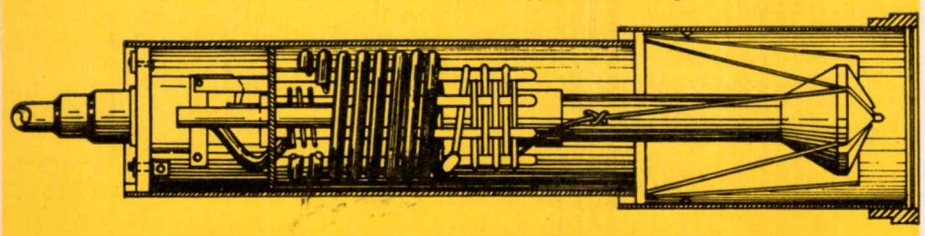
Considerable additional research was required to obtain the practical product available and used today. It consists of a cartridge type device built for installation in the tail cone of aircraft which is electrically discharged from the cockpit. Throwing a cockpit switch causes a small safety of fuse wire to be burned open, which releases a mechanical catch. This permits a heavy spring to eject a spindle on which is wound a 5-ft length of flexible resistance wire of 100,000 ohms resistance and a 5-ft length of 1/64" diam discharge wire at the rear end of which is a small paper wind cone. As the spindle kicks through a protective paper cap at the rear of the cartridge assembly it simultaneously projects the paper wind cone into the plane's slipstream. The pull of the cone then unwinds the 10-ft length of discharge and resistance wire which thereafter trails the aircraft. The static charge accumulated on the aircraft thereafter leaks off from the rearmost point of the discharge wire and the highly damped oscillations of discharge are prevented from reacting on the aircraft by the length of resistor wire between discharge wire and aircraft. The resistor wire is carefully grounded to the metallic mechanism of the discharge cylinder which is grounded to the aircraft structure. The resistor wire portion of the trailing wire acts similarly to the suppressor resistors frequently used on auto radio installations.

Larger aircraft normally carry two such discharge tubes, two being found necessary to properly discharge the larger aircraft while passing through large or severe areas of precipitation static. One tube is usually sufficient for smaller aircraft.

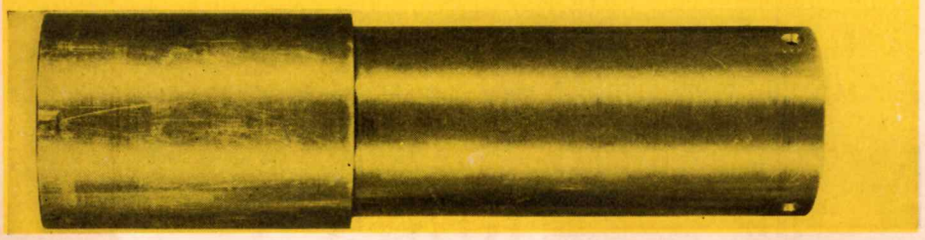
Use of this type of discharge device over a period of several years has indicated that there is still considerable to be learned about precipitation static and its elimination. For example, one airline operating in northerly latitudes where outside air temperatures are usually low whenever precipitation static conditions are encountered, reports almost 100% elimination of the interference by use of discharge tubes. However, another operator flying the southern latitudes reports little or no success. Still another operating from northerly to southern latitudes reports successful operation under cold air conditions and unsatisfactory performance in warm air areas. With so much still to be learned of the relations of meteorology, electricity and flight it is dangerous to assume much working knowledge.



Interior of the Bendix static suppressor cartridge



Discharge tube as loaded within its shell (shown below). The spring-loaded plunger when released kicks through the protective paper cover, carrying the wind cone with it, unwinding the discharge wire to trail the aircraft



Using a Static Discharge Wire

However, sufficient operational data has been obtained to indicate that if outside air temperatures are below 20°F such precipitation static as may be encountered will usually be greatly reduced if not eliminated by using a static discharge wire. Also, that if precipitation static is encountered with outside air temperature of 20°F or higher, it is of little use to eject a discharge wire; actually, it may be dangerous to do so. When outside air is above 20°F cloud structures are usually approaching a cumulus or nimbus condition—that of a thunderstorm. Any wire trailing behind an aircraft while in or near a thunderstorm condition, either building or active, only offers an increase of electrical length of aircraft and an invitation to a lightning strike.

Lightning may never strike an aircraft trailing a discharge wire or a transmit-

(Continued on page 151)

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

DIETZGEN DIRECTO

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The lines are denser, blacker.
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Printing is faster... there's more speed in this paper than your operator can handle.
Prints are uniformly high quality no matter at what speed your developing machine is run. No penalties from accidental slow-downs or speed-ups.
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This better process uses Domestic Chemicals. Quality is stabilized and sure; you can always be sure of *always* getting the same high quality work.

You will want to try this process at once... because it eliminates the "grief" that plagues you now... because the prints are so superior, the process so easy. We will gladly demonstrate the Dietzgen Directo Process for you . . . without cost or obligation.

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THE *SUPERIOR* BLACK AND WHITE DIRECT PRINT PROCESS **DIRECTO**

MORE FACTORY AREAS DEDICATED TO AIRCRAFT PRODUCTION

Aircraft Accessories

JOHN H. CASHMAN
Works Manager

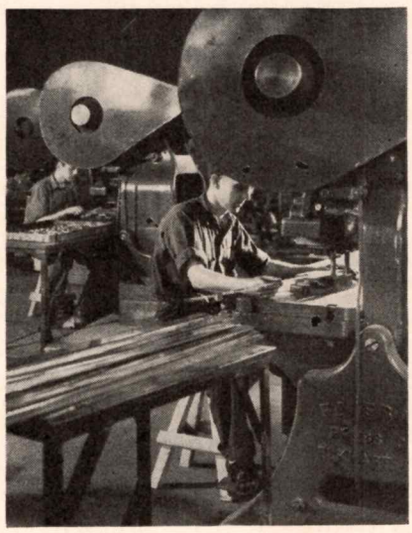
● Faced with a large backlog of orders that required increased production, Aircraft Accessories Corp., Kansas City, rather than attempt to step up production in an antiquated factory elected to put up a new building. The old plant had been in use long enough to show its inadequacies, and forearmed with this information, the architect was given the go-ahead signal on a new plant that would conserve space, promote production and streamline the plant for manufacturing purposes.

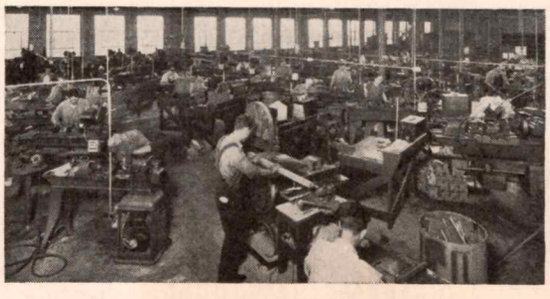
First note to increase the efficiency of the organization was to place the general office as close as practicable to the manufacturing space. This had been a desirable feature of the old building and had proved its effectiveness many times. Experience had shown the production office should be in a strategical position with relation to the planning, scheduling, purchasing and expediting departments.

Factory cost was part of this set-up and here at the first opportunity the company recognized the necessity for an optimum location of activities in the plant layout. Organization and the human element, being of extreme importance in the job to be done, were not forgotten, and a real functional plan developed as the building took shape on the design boards. A line and staff organization had previously prevailed, but this was discarded for the system which permits the specialist to function and which provides the greatest aid to rapid expansion. To cut operation cost, it was recognized that the production man should be as accessible to the foreman in the shop as the man on the lathe is to his foreman.

With the plant working on government contracts it immediately became apparent that incoming shipments of both job stock and raw materials would necessarily come under the supervision of the plant watch service. At the same time it would be imperative to observe government regulations on employees entering and leaving the building. The receiving and shipping departments as well as the employee entrance were accordingly planned for the rear of the plant where the watch service booth could command all entrances.

A pre-inspection of incoming materials is made possible by this arrangement, all shipments then passing to the inspection department. Flow of job stock is expedited as all freight is opened and ready for acceptance or rejection by the inspection department and can immediately be placed in stock or returned to the manufacturer. The layout of the department has been extremely simplified so that incoming material flows uninterruptedly in a straight line from the receiving dock to the stock room.





Aircraft Accessories expanded plant in Kansas City. Above, punch presses; below (left) radio shop assembly line; (center) the machine shop and (right) line of propeller governor test units

Handling of Material

This inspection procedure was applied with equal success to raw materials received in carload lots by planning the raw materials receiving dock in relation to the inspection departments and the railroad siding. This allowed an efficient operation as the inspection department can inspect, inventory and place in stock all raw material as rapidly as received. Disruption of the routine of the inspection department on job stock is eliminated.

The two stockrooms were so designed in the plant layout that all production facilities were close to them. Heavy raw materials flow easily and naturally from this stockroom to the foundry, sheet metal or machine shop with the shortest haul practicable. Job stock and small parts feed smoothly and efficiently to the small parts assembly in the shop. This section was placed at the best point in relation to the stockroom to give maximum production with minimum effort.

Experience gained in the old building was used to advantage in designing the layout of the electric power supply. This had shown that all power wiring had to be flexible and capable of being expanded quickly and easily.

A careful design of overhead conduit system was accordingly planned for the distribution of power to machines. The load was anticipated and the incoming line of 2350 volts was planned to utilize single phase 110 volt, single phase 220 volt and three phase 220 volt lines. These

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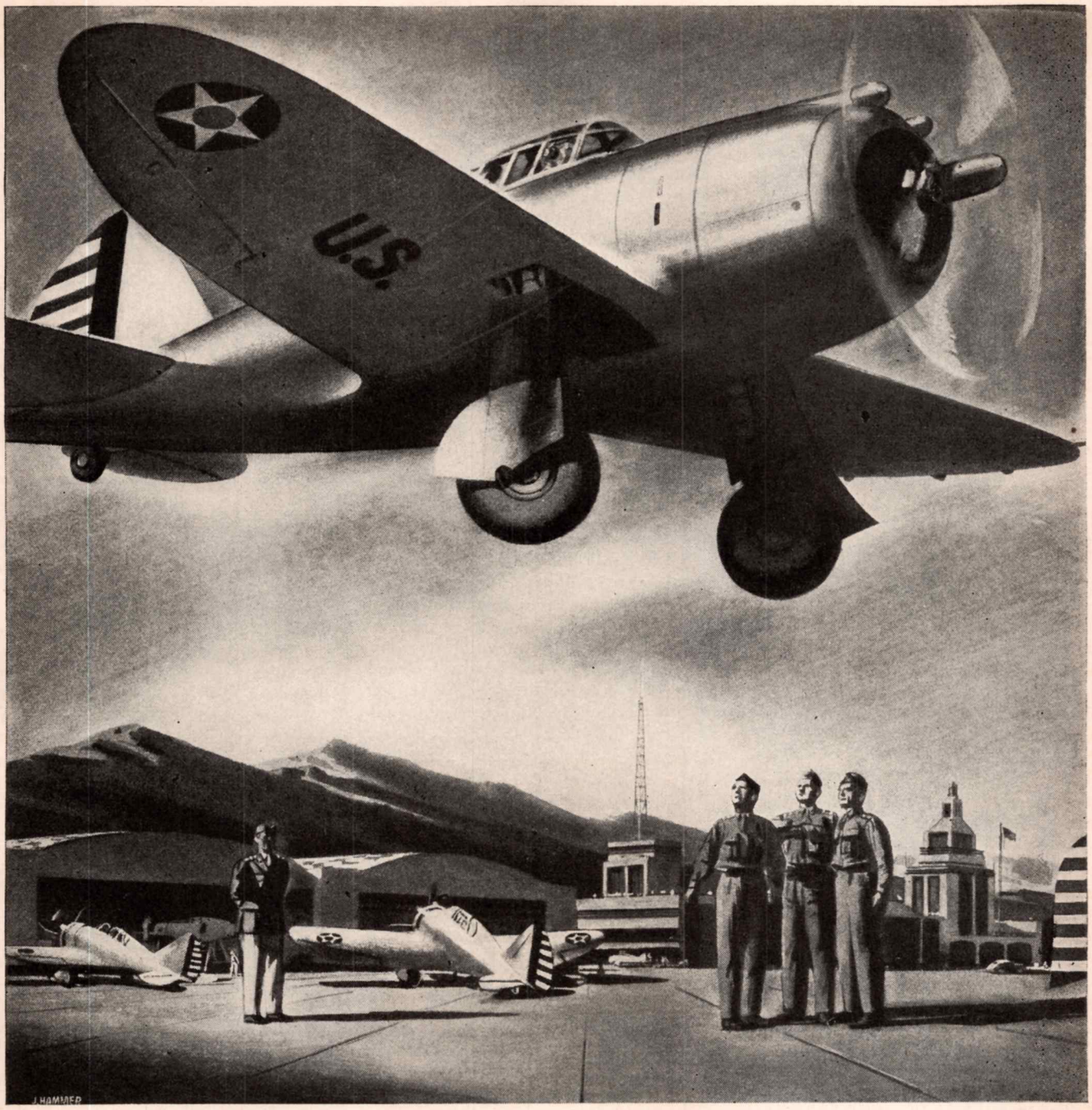
See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



"REPORTING FOR DUTY" by John Hammer

REPORTING FOR DUTY... On schedule, another Republic fighting plane completes its delivery flight. No arrival is more welcome to the pilots of the Army's interceptor commands, who daily chronicle the unsurpassed performance and dependable power of these high-altitude pursuit airplanes. Republic Aviation Corp., Farmingdale, L. I., N.Y.

REPUBLIC AVIATION

REPUBLIC AVIATION

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

(Continued from preceding page)
lower voltages are piped to boxes throughout the plant and no machine is more than 25 ft from a source of power at any time. This means that the entire plant, if the occasion should arise, can be dismantled, rearranged and moved back without sacrificing space or efficiency.

Safety was not neglected in this arrangement and each machine or power outlet has its own individual switch and fuse box. To provide further safety precautions, switches on the control board are only for the separate departments. Thus a machine may be overloaded or a fuse burned out without affecting the operation of adjacent machines.

Ventilation, heating and lighting were recognized in the plant design as being of prime importance for maximum efficiency. The monitor or sky-lighting system was planned to give a maximum amount of daylight so that the use of artificial light, even on the darkest days, could be held to a minimum. This was accomplished by providing oversize window lights coated with a special nonglare transparent paint.

Ventilation and heating were accomplished by the use of an overhead circulating fan system that provides adequate circulation of air during the summer months and a continuous flow of preheated air in the winter.

All available space was utilized to the fullest extent to effect economies in operation of the plant. Dressing rooms and balconies were built over the rest room facilities, as well as over the fire-proof vaults provided in the plant design for the safe keeping of company records.

Future growth was taken into consideration in the original plant design. With 50,000 sq ft of space, it appeared likely that production facilities would be adequate for some time. But it was recognized that government and commercial contracts would grow and expansion might become necessary overnight. Such a program, when required, can go ahead without upsetting plant routine because of foresight in planning the building.

A sound analysis of the building problem in advance of construction, recognition of facts necessary to provide adequate facilities, and good judgment in placing the essential requisites for large volume production have resulted in streamlining the manufacturing processes. Although even under these conditions improvements can always be made if the foundation is good and the job has been done in a logical manner, future expansion or elimination of undesirable features will always follow a natural course.

* * *

National defense plants now springing up all over the country in the greatest industrial expansion ever experienced are being built to last long after the war is over. That is significant.

No hastily thrown-together affairs, these new buildings are getting every modern development designed to assure maximum output in minimum time under conditions assuring peak efficiency and comfort for the worker. Those are things World War plants did not have.

Bomber Assembly Plants

Typical of the recent-day long-range cooperative planning for defense projects are the twin 4000 ft long Army bomber assembly plants now nearing completion at Ft. Worth and Tulsa. These plants are being provided with a new type of shatter-proof, non-combustible side wall and roof construction combining three types of glass fiber and prefabricated steel panels.

Engineers of The Austin Company, who designed both plants, evolved the combination which utilizes products developed by Truscon Steel Co., and Owens-Corning Fiberglas Corp., in a new approach to the problem of insulating vast factory areas for economical year-round air-conditioning.

With 203 carloads of fiberglas required for each plant, they will probably contain more glass in their steel side walls and roof than the largest daylight factories ever built. By blanketing all interiors with several layers of these materials, which are calculated to eliminate or control condensation and to reduce heat transference to a practical minimum, the cooling load has been substantially reduced.

The plants are so large, however, that each requires 7000 tons of refrigeration, which is more cooling than that installed for all the central air-conditioning systems at Rockefeller Center.

These facts, and other features designed to insure year-round working comfort, economical operation and production efficiency in the two plants, where a total of 30,000 men will be soon assembling four-engined bombers on moving assembly lines, were disclosed last month when the Austin organization started erection of side walls for the Fort Worth plant.

There, alternate layers of fiberglas and special vapor seal paper, held together with asphalt, are being combined with steel-channels, roofing sections and metal lath to give the walls and roofs maximum strength and the highest obtainable acoustical, insulating and light-reflecting qualities.

Both plants are being built for the War Department under direction of the U. S. Corps of Engineers, who have a staff of 30 engineers and 238 inspectors, auditors and clerks on the job at Ft. Worth. Austin has its own staff of 102 engineers and 20 clerks at work on plans, specifications and the detailing of mechanical equipment and production layouts for the two plants in a downtown office building there, where Consolidated Aircraft Corp., which will operate the Ft. Worth plant, has its own consulting engineer.

Another group of 147 Austin engineers, superintendents, auditors, purchasing agents and clerks are located in field offices on the 1450-acre plant site overlooking Lake Worth, where 3500 construction workers are building the plant on a two-shift schedule. This crew will soon reach 6000.

Manhattan - Long Construction Co., general contractors for the Tulsa plant which will be operated by Douglas Aircraft Co., is using nearly a million dollars' worth of construction equipment, ranging from huge graders, trucks, cement mixers, hoists and erecting cranes to wheelbarrows and small hand tools. There is about the same amount on the ground at Ft. Worth.

The 27,000 tons of structural steel required for each plant was more than any single steel mill or fabricating shop could deliver in the limit time allowed. Bethlehem Steel Corp. has been able to meet the required schedule on steel for Ft. Worth, however, by distributing this work among seven of its plants at different locations. Several companies have cooperated in production of the steel for Tulsa, which is being fabricated under a contract with the Midland Structural Steel Co. of Chicago, in seventeen shops throughout the Mississippi Valley and the southwest.

Because all of the 171 200-ft trusses required for the main aisle of each plant are 25 ft deep and an equal number of 120-ft trusses for the side aisle are 16 ft deep, making them too high for shipment in completed segments by rail, they are being assembled on the site. While most of these spans weigh 40 tons and 25 tons and can be assembled on the ground and raised into place in one piece, 115-ton jack trusses of 200-ft span are being assembled in place with the aid of heavy falsework.

Only one 200-ft hangar door opening has been provided in each plant, that being at the end of the assembly line. These doors, and eight 200-ft doors in the nearby hangar building, will be of the Truscon vertical lift type, installed in units 100 ft wide to operate independently of each other. Four 150-ft single unit doors of the same type will be used in the paint shop. All will be 40 ft high and insulated in a manner comparable with the side walls, with weatherproofing at jambs in keeping with the requirements of air-conditioned buildings.

Truscon has been fabricating the doors, the steel panels, expanded metal lath, clips and other erection fittings at its plant in Youngstown. The fiberglas

(Continued on following page)

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

PATTERN *for* POWER

BEHIND the casting of a cylinder head for a Cyclone 9 lies a quarter of a century of painstaking foundry experience. Patient experiment with metals and sands has produced a technique for dissipating the roaring heat of explosions which create 1250 fifteen-ton power impulses a minute and make possible the 133 horsepower produced by each cylinder.

From the deft hands of master craftsmen have come moulding processes so expert that fins of metal as high as 2¼" and as thin as .064" can be formed by pouring molten aluminum into ordinary sand. These fins constitute the more than 15 square feet of surface that regulates the temperature of each cylinder when Cyclones power the ships of commerce and defense.

WRIGHT
Aircraft **ENGINES**

WRIGHT AERONAUTICAL CORPORATION • PATERSON, NEW JERSEY

Division of Curtiss-Wright Corporation

(Continued from preceding page)

products are being produced at the Owens-Corning plants in Newark, Ohio.

The assembly buildings and a majority of the auxiliary structures at each plant have an overall height of 65 ft. A 13" curtain wall of face brick and acoustic block, which is being specially reinforced with trussed rods to make it shatterproof, rises to a height of 12 ft around the base of all buildings. The special insulated metal wall extends from that point to the roof. Fiberglas insulation board continues down to the base of all walls through the masonry in order to insure complete control of condensation. Even the bolts used to anchor the upper walls to steel girts are being insulated to prevent continuous steel contact between exterior and interior.

The roof and wall construction will be uniform in all buildings at each site, including a two-story office building, a maintenance shop and boiler house, all of which adjoin the 4000-ft-long assembly building, and a paint shop, hangar and cafeteria buildings, which are separate structures.

By blanketing the interior walls of each structure with white fiberglas, the engineers have not only provided for insulation and absorption of between 60 and 75% of factory and office noises, but have also obtained a light-reflecting surface which will maintain brightness at a high level. Each assembly building will have 17,000 new type two-tube 200-watt GE rectified fluorescent units for high bays, to provide at least 35 ft candles at the working plane in continuous service. A white cement floor will enhance general lighting efficiency by reflecting light up on the underside of parts and planes on the assembly lines.

Each plant has been designed with two mezzanine levels alongside the assembly line, for storage of various parts and subassemblies convenient to the particular assembly station where they will be installed. These mezzanines are suspended from the 120-ft trusses spanning a secondary aisle beside the 200-ft assembly section, and are supported on one side by the center columns.

It was necessary to provide some passage for monorails from aisle to aisle at intervals along the assembly line, and this need has been met by limiting the length of mezzanines to 450 ft so that there are seven 50 ft transfer aisles available for monorail crane connections. This has resulted in the creation of eight separate mezzanines at each level, 30 ft by 450 ft, and these are served by eight rotary lift hydraulic elevators large enough to handle all but the heaviest parts and bulkiest sub-assemblies, as they are received by truck or rail.

With food wagons and first aid stations, tool cribs, washrooms and toilets located directly below the mezzanines or on them, no obstructions will impede the free operation of the interconnecting monorail systems which will serve the entire area of each assembly building. They will be capable of carrying a fully assembled 4-engine bomber the entire length of the assembly aisle where 40-ft clearance has been maintained, or of transferring other overhead loads up to 20 tons between any two points in the 1,294,000 sq ft building area.

Bombers will progress through the final stages of assembly on parallel conveyors extending nearly 2000 ft through the assembly aisles, every portion of which will be served by a network of power lines in some 10 miles of underfloor service duct.

Each plant will have a connected power load in excess of 15,000 kva and an average demand of 10,000 kva, of which 300 kva will represent lighting for the general assembly building. Power will be distributed through 10-unit transformer substations of 600 capacity on platforms in the trusses at each plant, and these will reduce 4160 volt primary to 440 volt secondary for distribution through a three-phase 4-wire system. A 625 kva steam turbine generator will meet emergency light and power requirements at each location.

Each plant will have three combination gas and oil fired boilers furnishing 300,000 lb of steam per hour at 225 lb pressure; three air-compressors each with a capacity of 1500 cfm; and three fire pumps capable of delivering a total of 4500 gpm to the plant sprinkler systems and fire stations on various parts of the site.

More than 750,000 cu yd of earth had to be moved in grading at each plant, where more than 150,000 cu yd of concrete and 4000 tons of reinforcing steel will be required. There will be 1,490,000 sq ft of concrete floors in each assembly building, more than 150,000 sq ft in the aprons and another 175,000 sq ft of

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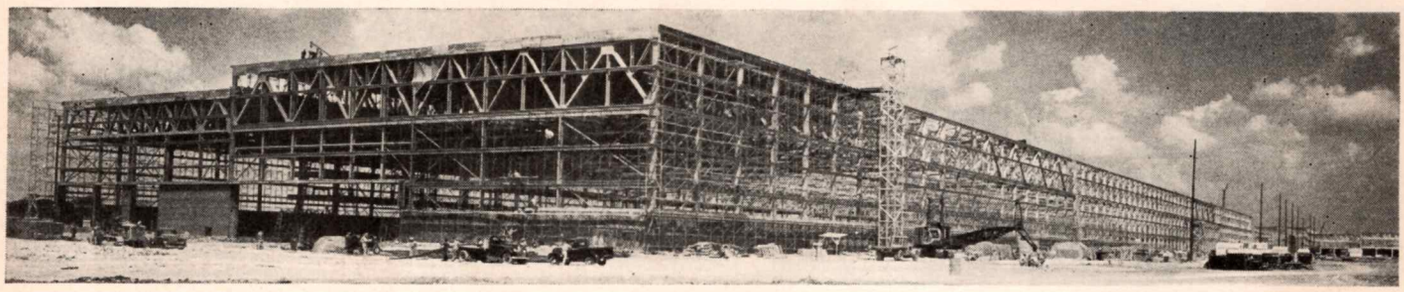
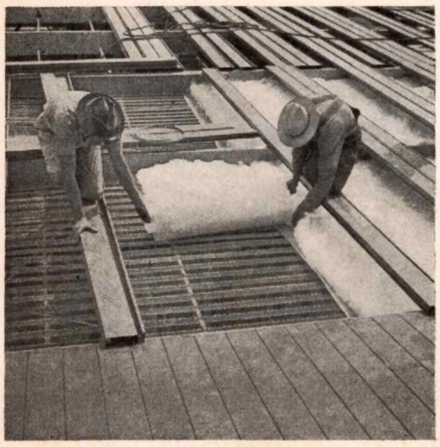
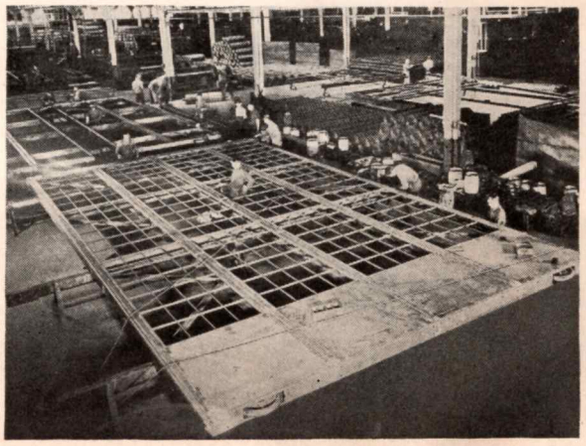




Army bomber assembly plants now under construction like the one above at Fort Worth, Texas, will be insulated with layers of Fiberglas as shown at the left. At the right is shown the assembly of one leaf of a Truscon vertical lift type steel door for one of these plants



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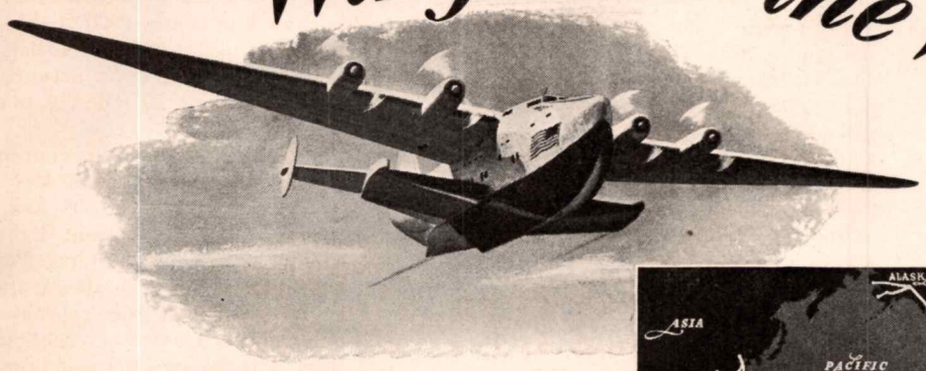
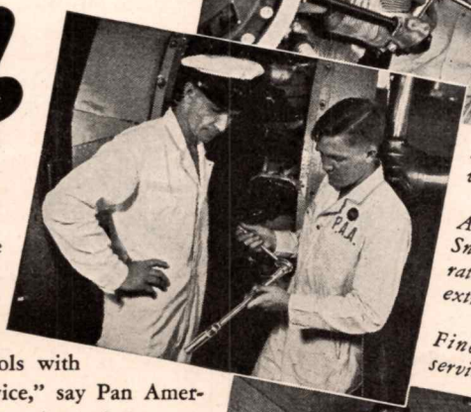
Wings over the World!



PAN AMERICAN AIRWAYS

pioneers to leadership in trans-ocean flying . . .
maintains famed service standards with

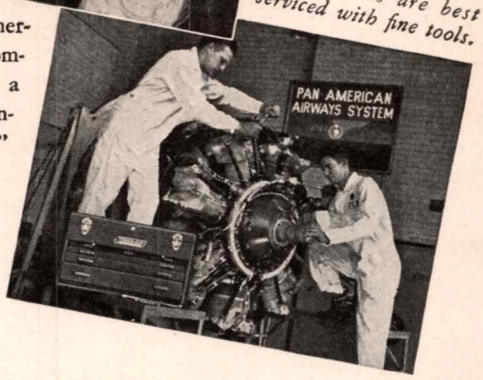
Snap-on Tools



It's a pleasure to work with a Snap-on!

An especially efficient Snap-on combination . . . ratchet, nut-spinner and extra-deep socket.

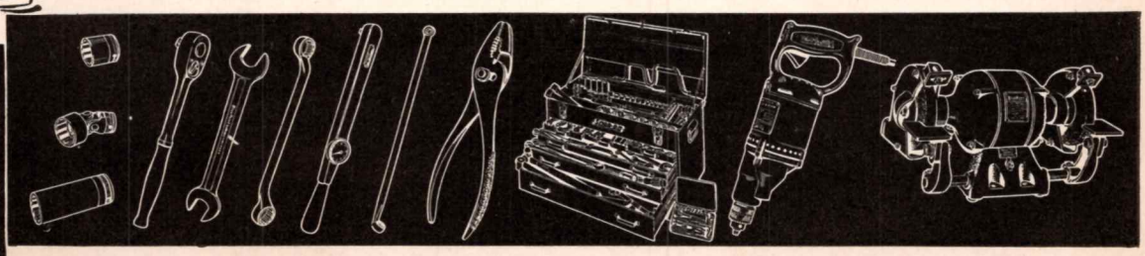
Fine motors are best serviced with fine tools.



The dramatic pioneering of America's Merchant Marine of the Air is a saga of bold vision, expert operations and *painstaking maintenance.* Wherever Flying Clipper wings beat over world-wide routes, Snap-on tools are relied upon for vital operations in that maintenance. "We have used Snap-on tools with confidence and satisfaction since the earliest days of our service," say Pan American's maintenance superintendents. "We're averaging 98.62% of schedule completion, on a 77,854-mile system, and dependable tools are as essential to such a record as expert pilots. In the shops of both seadromes and airports, our mechanics praise Snap-ons for ease of handling, working-speed, accuracy and long life."

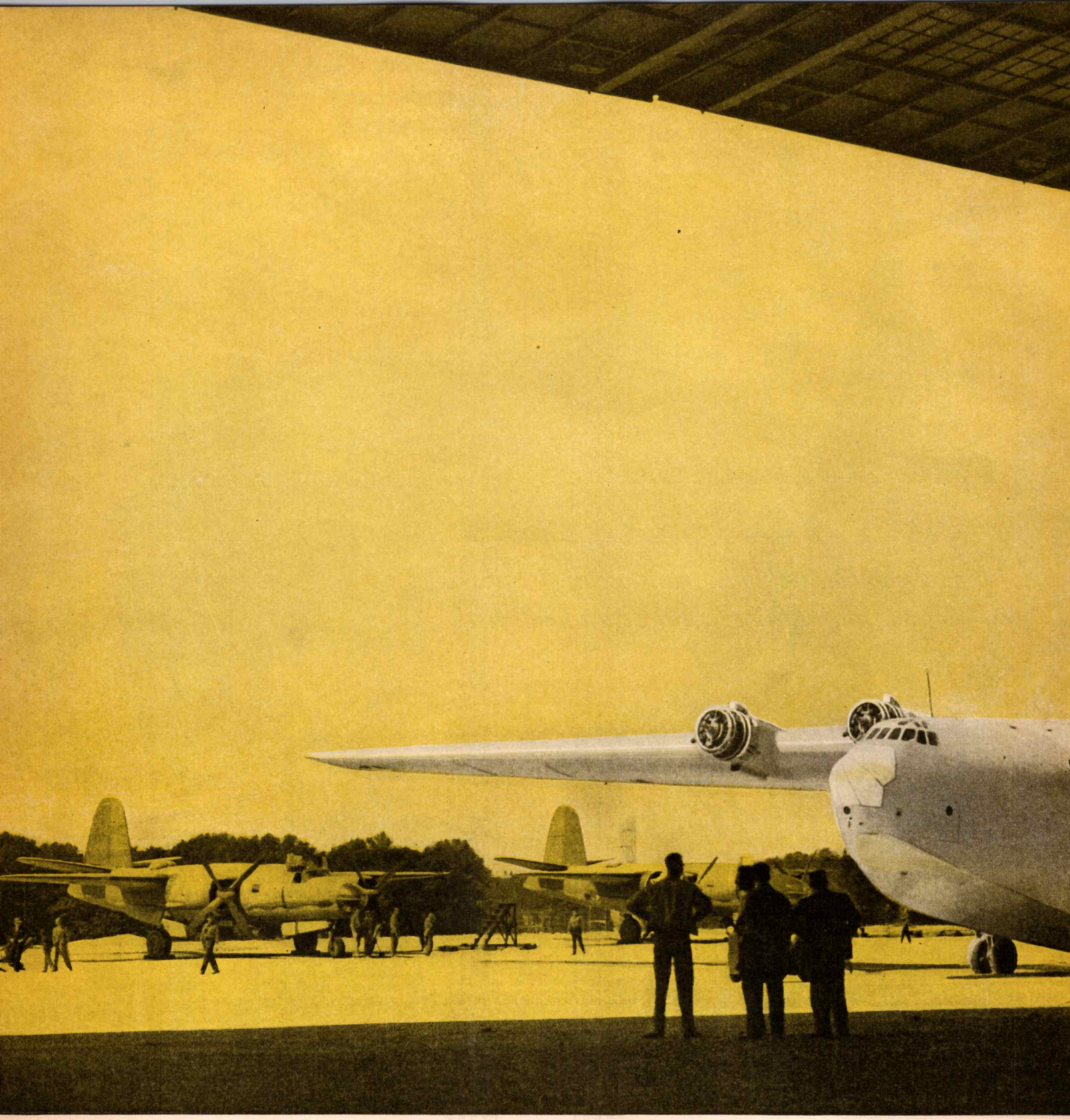
Thus another famed air-line testifies to the high quality of Snap-on tools . . . as dependable in aviation as in the automotive and industrial fields where "Snap-on" has been a name for tool-leadership for 22 years. 3,000 Snap-on tools and direct-to-you service are conveniently near you from 34 factory branches throughout America. Write for catalog and full information . . .

2200 HAND AND POWER TOOLS — FROM MIDGET WRENCHES TO HEAVY DUTY UNITS



SNAP-ON TOOLS CORPORATION, 8022-K 28th Ave., Kenosha, Wisconsin

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

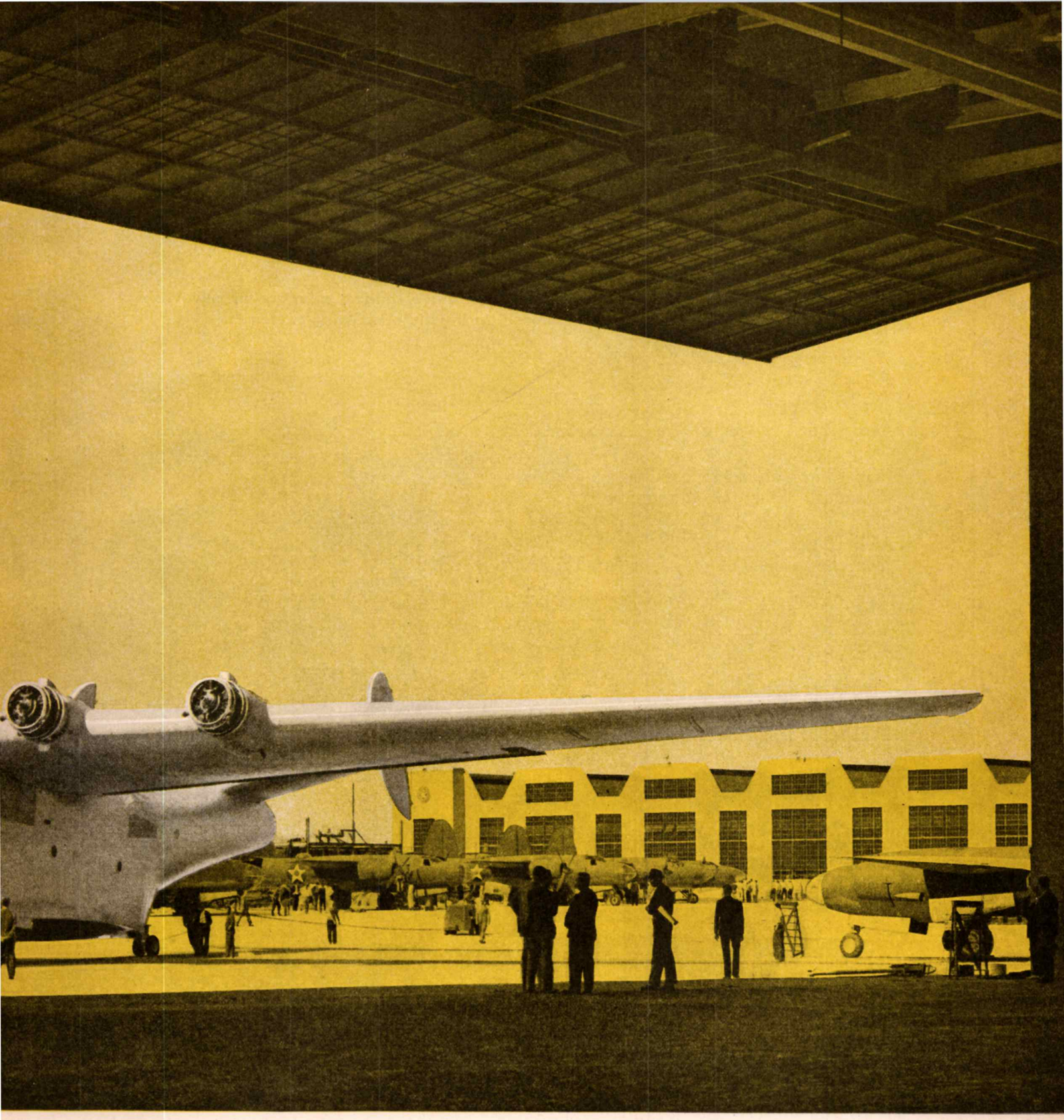


PREVIEW

—THROUGH

A TRIBUTE to Martin engineers and workmen was the Navy's order to create the world's largest flying boat. The mighty XPB2M-1 introduces a new era in over-ocean flying. Your Navy, in foreseeing the need for such a plane, displayed the vision which

THE GLENN L. MARTIN COMPANY,



OF TOMORROW

THE WORLD'S LARGEST DOOR!

has made American ships . . . both of the sea and of the air . . . second to none. In the XPB2M-1 the Martin Company has done more than give America a great new weapon . . . it has given the world a preview of the even greater flying boats yet to come.

BALTIMORE, MARYLAND, U. S. A.

Martin
AIRCRAFT

Builders of Dependable MARTIN U.S.A. *Aircraft Since 1909*

TRADE MARK

TWO IMPORTANT ANNOUNCEMENTS

(1) ADVERTISING RATE INCREASE

(Effective January 1st, 1942)

Expanding circulation and increasing costs necessitate a modest advance in advertising rates. Current rates will be honored during life of existing contracts.

The new scale, to be known as Rate Card No. 6, is as follows:

		Within one year from date of first insertion		
SPACE	ONE TIME	3 TIMES	6 TIMES	12 TIMES
PAGE (Black & White)	$265.00	$250.00	$240.00	$225.00
		(24 or more black and white pages a year, $215.00 per page)		
PAGE (Black and Standard Red, Standard Blue or Standard Yellow	310.00	295.00	280.00	265.00
PAGE (Black and one Matched Color)	325.00	310.00	295.00	275.00
		Metallic Inks on request		
HALF PAGE	145.00	138.00	130.00	125.00
QUARTER PAGE	80.00	76.00	72.00	68.00
EIGHTH PAGE	45.00	43.00	40.00	38.00
		Inserts on request		

RATE HOLDER and minimum size display, one-eighth page

BLEED COPY ..... Black and white page, $35 extra; black and one color, $45 extra; two facing pages, black and white, $45 extra; two facing pages, black and another color, $55 extra.

SPECIAL POSITIONS ..... Page one, first advertising page in feature editorial section, page facing Editorials, page facing "Aviation Engineering" title page—15% extra. Pages 2, 5, and first advertising page in News section—5% extra. Island half pages—15% extra.

(2) CHANGE IN SIZES TO N.I.A.A.-RECOMMENDED STANDARDS

(Effective with January 1942 issue)

The National Industrial Advertisers Association, Inc., for the past several years has recommended that publishers standardize the Trim Size of industrial publications. Beginning with the January issue, AERO DIGEST will reduce its Trim Size from 9" x 12" to the recommended 8¾" x 11⅝". This change calls for several slight changes in the dimensions of the various advertising units, as follows:

PAGE—Bleed Size	8⅞" x 11⅞"
PAGE—Trim Size	8¾" x 11⅝"
PAGE—Type Size	7" x 10"
HALF PAGE	7" x 4⅞" 3⅜" x 10"
QUARTER PAGE	3⅜" x 4⅞" 7" x 2⅜"
EIGHTH PAGE	3⅜" x 2⅜"

These same changes in sizes will apply also to REVISTA AEREA effective with the January 1942 issue.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

BREWSTER AIRPORT
BUCKS COUNTY, PA.

JAMES WORK

Chairman, Brewster Aeronautical Corporation

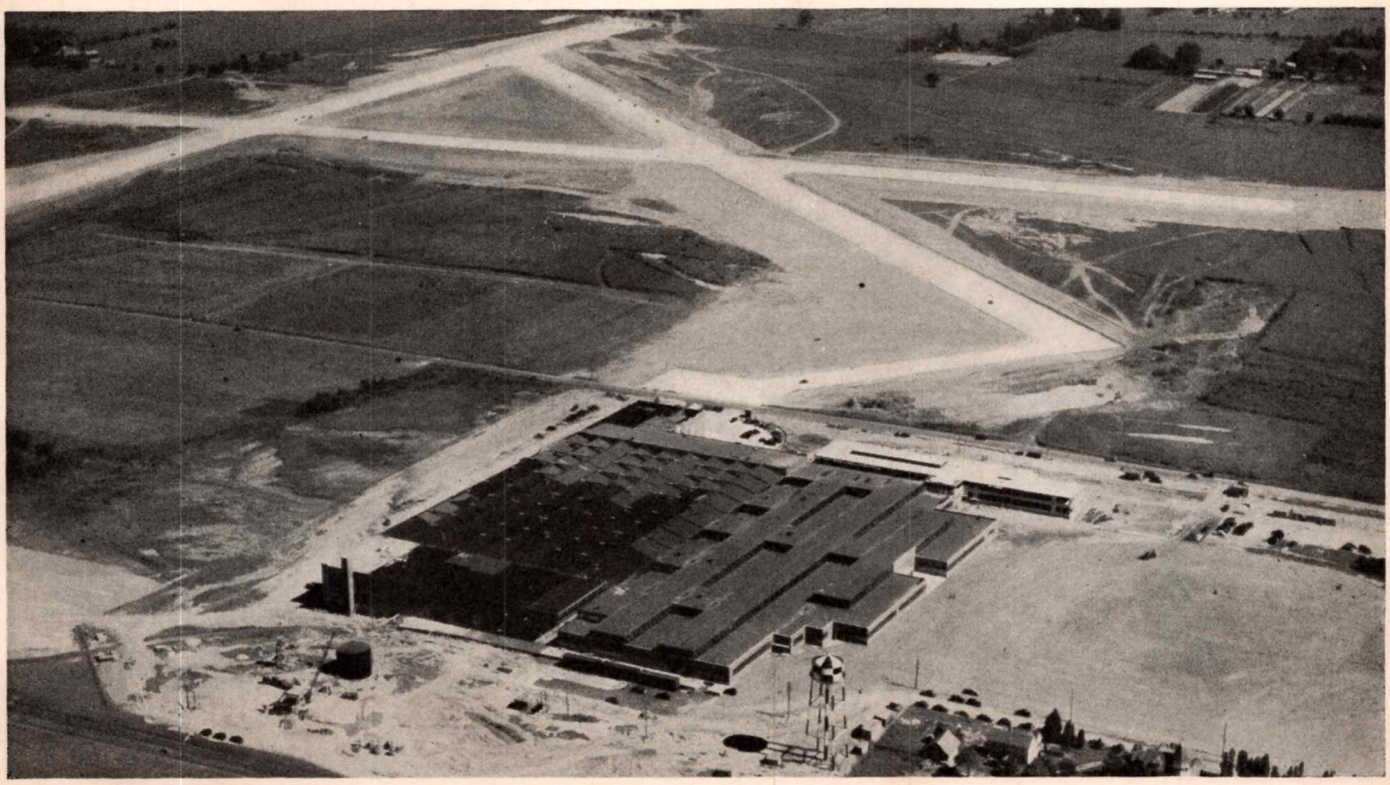
The author of this article personally selected the site for the new Brewster Johnsville assembly plant and the airport he describes.

● When the Brewster Aeronautical Corp., in order to cope with a rapidly increasing backlog for *Buffalo* fighters and *Buccaneer* and *Bermuda* dive-bombers, found it necessary to expand further and construct a new 500,000 sq ft assembly plant, time, as always these days, was of the essence. In addition to the construction of a factory building, there had also to be built an airport of sufficient size to provide for the testing of the aircraft that would roll off the assembly lines when the plant was placed in operation.

Normally, the building of an airport, at a rapid rate, is an extremely costly venture. Prior to the present era, a year was not considered an unwarranted length of time in which to construct a fair sized, well equipped airport with Class 2 or 3 rating. Brewster could not wait that long. The airport had to be completed at the same time as the factory, or sooner, if possible. This factor, consequently, was an important element in the selection of the site for the proposed plant. After surveying several possible locations, a 372-acre tract at Johnsville, 18 miles from Philadelphia, Pa., was chosen for the plant. This tract, situated in the farming region of Bucks County, was relatively flat and was located on the 360 ft contour line, the highest contour within a radius of 10 miles.

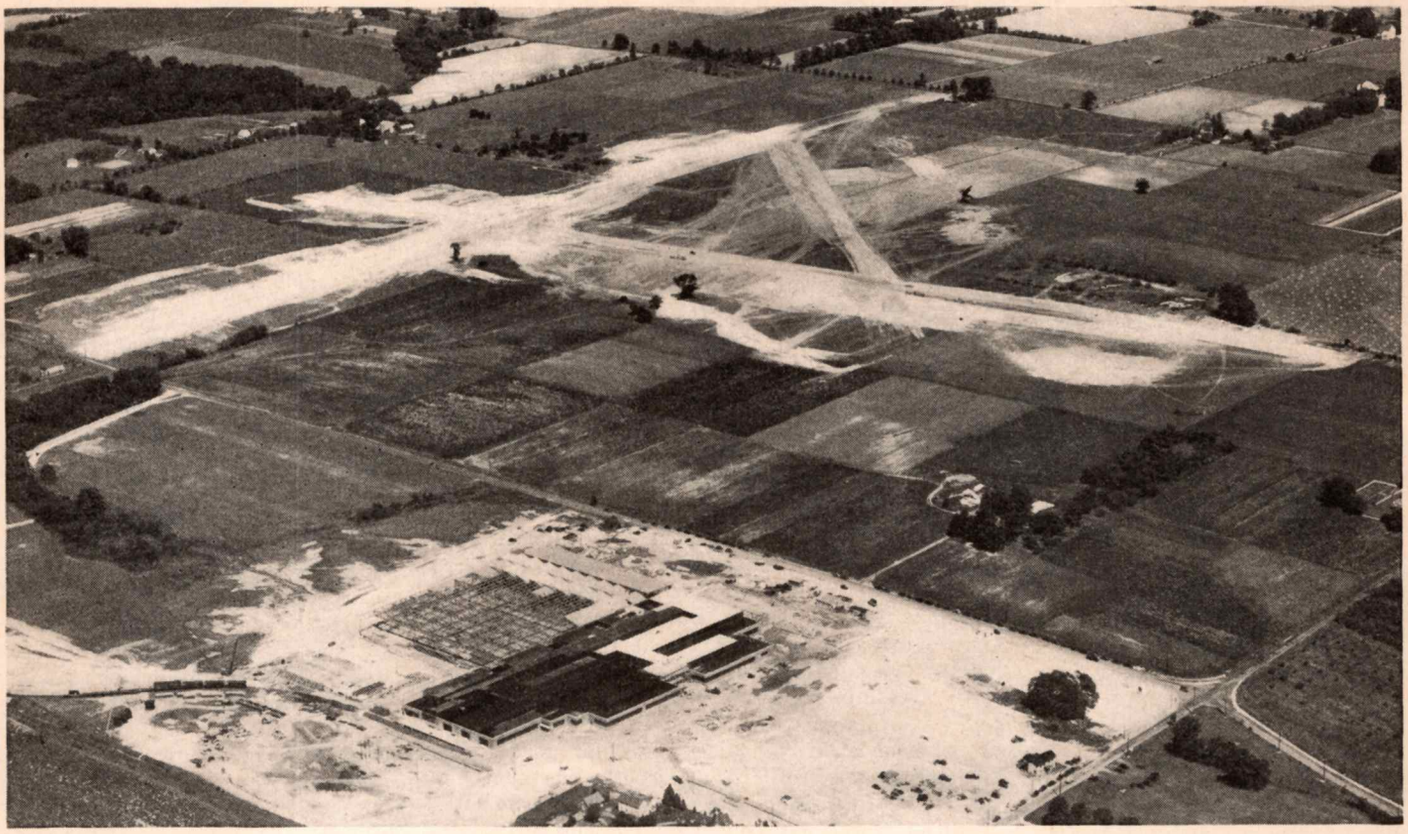
Approximately 300 acres of this tract, bounded rectangularly by four roads, was selected for the airport. The site was just about ideal for the purpose for which it was bought as the movement of only about 160,000 cu yd of earth was required to obtain the proper grades. Beyond this, however, there arose the same costly and time consuming problems generally encountered in the building of any airport with paved runways—until we decided to investigate the possibilities of substituting soil-cement for the conventional macadam or concrete pavement.

At first, this process sounded fantastic for satisfactory use in paving airport runways. It consists of mixing a low percentage of Portland cement with the soil (the exact amount to be determined by soil analysis) and subjecting the mixture to special processing to obtain a hard-surface. Engineers explained that 95% of all known soils could be processed in this manner; not all of them economically, however. It seemed that when cement was added in the right ratio to a soil in a stable condition and mixed with water and the resultant mixture compacted to the proper density, the hydration of the cement, an insoluble binder, tied the soil grains together to form a pavement not unlike poured concrete in appearance and general characteristics. The success of runways paved by soil-cement, it was pointed out, depended on the proper analysis of the soil to determine the percentage of cement



Aerial view of the new Brewster Airport, showing the 3000 foot soil cement runways; in the foreground is the Brewster assembly plant

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



Brewster Airport as it appeared on July 15; many trees and houses have since been removed

to be used and the manner in which the process of mixing cement and water with the soil and compacting or "pressing" the mixture was carried out. In analyzing the soil, actual field conditions under seasonal variations are simulated in the laboratory to determine durability during periods of freezing, thawing, *etc.*

The soil-cement process, it was learned, had been used by the U. S. Air Forces in the construction of Westover Field at Chicopee Falls, Mass., and by others in the construction of several airports in New England and Canada. Information as to its durability under heavy traffic conditions was meager but the speed with which soil-cement runways could be laid and the saving in cost for equivalent depth of pavement over macadam and concrete were attractive features of this type of construction. The process which, in our case, we were informed, would involve the use of 15% by volume of Portland cement mixed with the soil, offered us an opportunity of saving upwards of 40% over other types of pavement. It would be, we were assured, guaranteed for 10 years. On the basis of this information we decided to be the "guinea pig" among aviation manufacturers and proceed with the construction of an airport with soil-cement runways.

To supervise the construction of the Brewster Airport, we selected Charles McLaughlin, president of the Metropolitan Airport Association, and an engineer who was, for a number of years, affiliated with the Airports Division of the Curtiss-Wright Corp. C. T. Burket who had just completed the new Defense Airport at Millville, N. J., was chosen for the general airport construction and D. W. Winkelman & Co. of Syracuse, N. Y., was awarded the contract to lay the soil-cement runways. Winkelman also was the contractor who laid the soil-cement runways for the Army airports at Westover Field, and at Windsor Locks, Conn., as well as for the Tri-State Airport at Binghamton, N. Y. A pioneer in applying soil-cement, Winkelman has developed special processing equipment which reduces the time required to lay soil-cement pavement from weeks to days.

Battery of five rotary tillers mixing soil with cement

The first bite was taken out of the airport site by a bulldozer on June 2. Less than 5 months from the time grading was started, three runways, each paved for 2800 to 3000 ft of its length, had been completed. Not only had the airport been built in what, on the basis of past performance, was an unbelievably short space of time, but the anticipated saving in cost had been fully realized. It was a source of satisfaction to us that between the time we decided to go ahead with the soil-cement and the time the runways were laid, we received reports from Westover Field and other points where soil-cement runways had been subjected to heavy traffic. These reports, which fully justified our confidence as to the durability of soil-cement runways, stated that no wear had resulted from the constant landing of military aircraft of the size of the Boeing Flying Fortresses.

As noted above, the Brewster airport is located on the 360 ft contour level,

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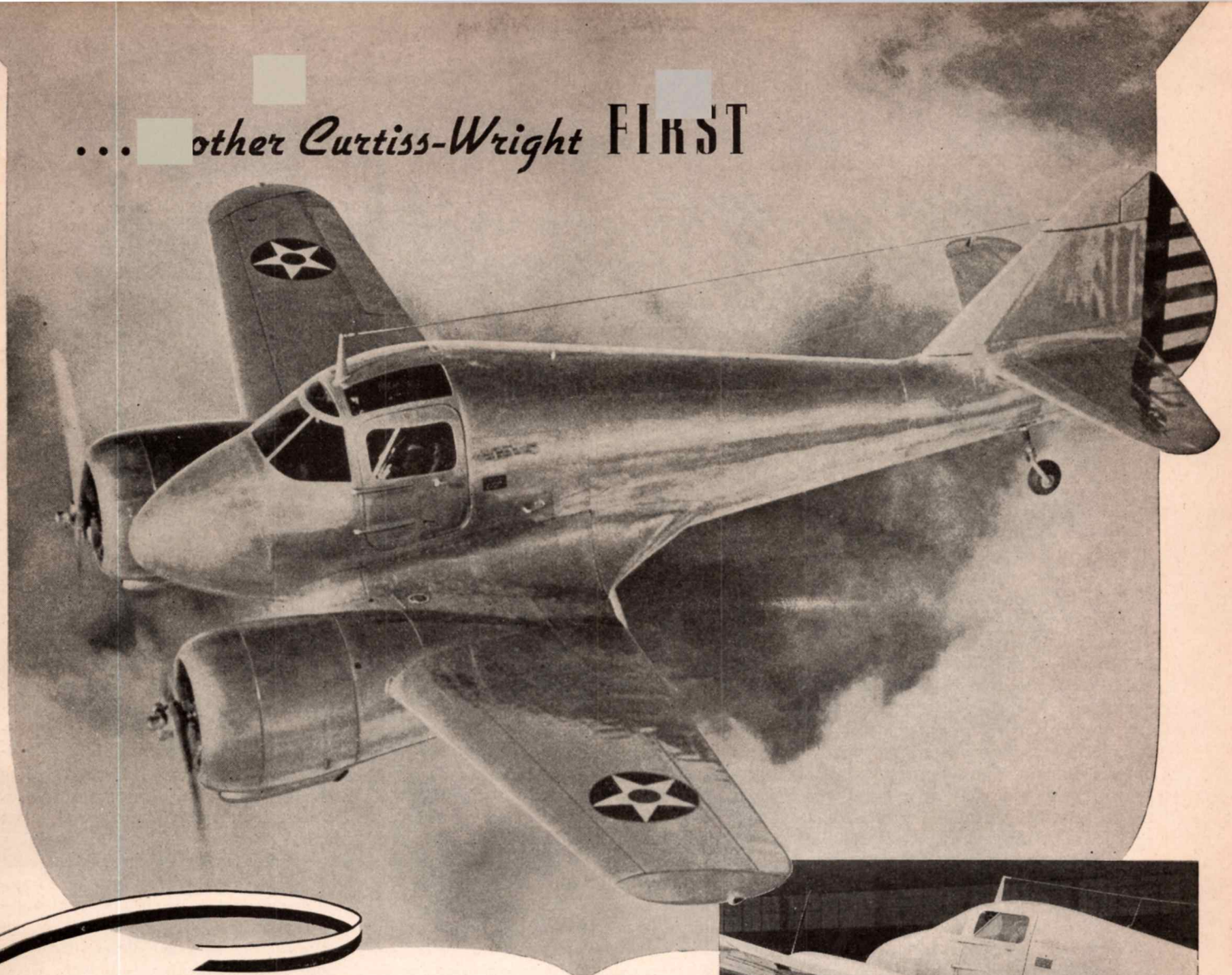
See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

... another Curtiss-Wright FIRST



The CURTISS AT-9

... the quicker step from Trainer to Bomber

The Curtiss AT-9 is the most recent of a line of trainers whose history began with the famous Curtiss JN-4 in the days of World War I.

DESIGNED to save thousands of precious hours of advanced training, the new Curtiss AT-9 provides the United States Army Air Corps with a new and quicker step from single-engine trainers to speedy pursuit or multi-engine bombers.

The new trainer simulates the flight and control characteristics of modern high-speed twin-engine military aircraft. Its design fortunately is such that it is ideally adapted to mass production, a vital factor in developing the equipment necessary for training the thousands of pilots needed for the nation's defense.

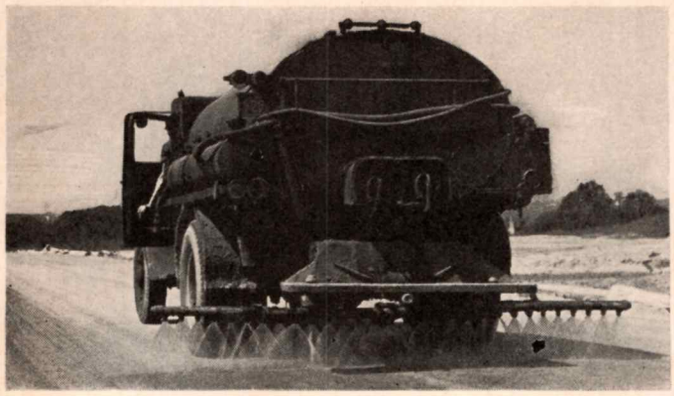
This Curtiss "Transition Trainer" is powered with two 280-horsepower radial engines and has a top speed in excess of 200 miles an hour. It has two seats side by side with provision for two additional observers' seats immediately back of the pilots.

CURTISS-WRIGHT

CORPORATION

AIRPLANE DIVISION

BUFFALO, NEW YORK · COLUMBUS, OHIO · ST. LOUIS, MISSOURI



Power sprayer distributing water over soil cement to insure a constant 13.5% water content

Latourneau "Carryall" used effectively in some of the grading operations at the Brewster Airport

(Continued from preceding page)
all other contours in the vicinity being 280 to 340 ft. In addition, it is 10 to 15 miles from the center of any existing airway and has perfect approaches from any direction. All trees, high brush and several farm buildings were removed in order to obtain clear approaches to the runways which measure as follows: NW-SE runway, 3450 ft total length, 2800 ft paved; NE-SW runway, 4600 ft total length, 3000 ft paved; and E-W runway, 5100 ft total length, 3000 ft paved. All runways are 100 ft wide and are crowned or banked and sloped. As the ends of all runways can be seen from the end of any one runway, a control tower would not be necessary for the operation of the field. No runway has a slope in excess of 1.5%. For instance, the E-W runway slopes only 16 ft over its total paved length of 3000 ft or little more than .5%.

Although the airport site is located in a naturally drained area in the Nechaminy watershed, vitrified tile drains in sizes ranging up to 10" in diameter were laid along the sides of each runway to guard against unusual precipitation and sudden thaws. To insure against breakage, drains crossing beneath the runways are of reinforced concrete pipe with sealed joints.

Actual construction started with the stripping of topsoil from the areas to be graded in order to obtain the perfect compaction made possible by filling with sub-soil on sub-soil. This precaution, which should be taken wherever an airport is built, was particularly important in the building of the Brewster airport which previously was the site of highly productive farms. If top-soil were promiscuously mixed with sub-soil in grading and filling, perfect compaction would be impossible as the top-soil, containing a high percentage of organic material would eventually decompose causing voids and erosion ditches. All top-soil stripped from the graded areas was placed in storage piles and later replaced uniformly over all areas excavated or filled between or adjacent to the runways. In this replaced top soil, when all grading had been completed, was sown a carload of the finest grass seed to insure that the airport eventually will have the appearance of a huge lawn transversed by the runways. A number of Bucks County farmers were employed in constructing the airport.

After the runway areas had been cut and filled to the proper grade, a trough 6" deep and 100 ft wide was excavated between the exact lines of the runways. It would have been possible, as originally planned, to have obtained a satisfactory pavement by mixing 15% of Portland cement with the soil excavated to form these troughs. It was discovered, however, that if sand and gravel taken from a "borrow pit" on the property were used, a further saving in cost could be effected. The "borrow pit" soil analysis disclosed that sand and gravel required only 10% by volume of cement as against the 15% by volume of cement required if the original soil were used. Cost of transporting this sand and gravel to the runway troughs was the equivalent of only 2 of the 5% of cement saved by use of the "borrow pit" material, enabling us to realize an ultimate saving equal to the cost of 3% of cement we used in the project.

The runway troughs were filled with 7"-8" of the "borrow pit" material and initially compacted and smoothed by means of special equipment. The cement

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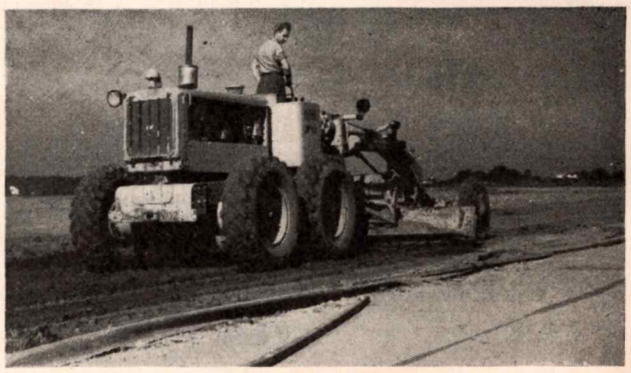
Spreading cement over the soil prior to start of mixing operations with rotary tillers



Road grader employed on side areas adjacent to the soil-cement runways

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

Unparalleled for deep drawing of steel, H-P-M Fastraverse Presses handle duralumin with equal efficiency. The large gasoline tank parts being pressed at the Douglas Santa Monica plant are typical of the important role H-P-M "all Hydraulic" equipment is playing in industry's "all-out" defense production. What is Your Pressing Problem?

THE HYDRAULIC PRESS MFG. Co.
Mount Gilead, Ohio, U. S. A.

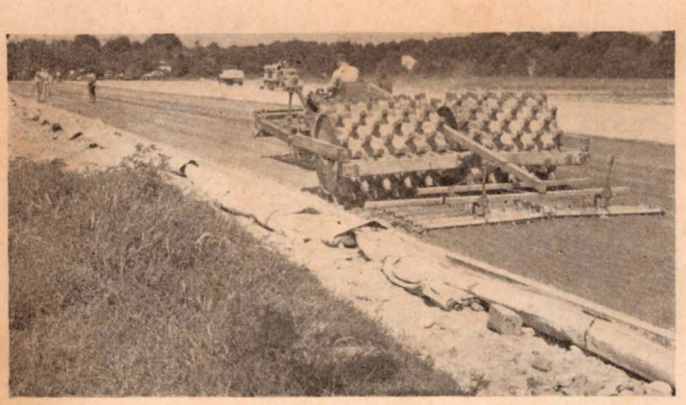
District Sales Offices: New York, Syracuse, Detroit and Chicago. • Representatives in Principal Cities.

THE AIRCRAFT INDUSTRY ADOPTS

H·P·M Fastraverse Blankholder Presses

FOR DEEP METAL DRAWING ★ ★

Upper gasoline tank section for Douglas C-47 cargo carrier or troop transport. Specifications 10-$\frac{5}{8}$" deep × 77-$\frac{3}{4}$" long x 32-$\frac{1}{4}$" wide. Material .064" thick Alum sheet 3SO.



"Sheep's foot" roller in operation. This device starts compaction from the bottom up. At the right is a power roller compacting the final half-inch of surfacing

(Continued from preceding page)

was then spotted in piles over the sand and gravel and brushed evenly over the surface. The mixing of the cement with the soil was the work of a special machine known as a rotary tiller, a battery of five being employed for this work.

While the rotary tillers were at work the soil engineer carefully determined the amount of moisture in the mixture before adding more water. The water wagons were then brought into play. The "water wagons" which resembled the type of apparatus used to spread tar over a road, shot water into the soil-cement mixture under pressure from a bar sprayer. Closely following the water wagons came the rotary tillers again mixing the water with the soil-cement combination. This process continued, successive increments of water being added, until the soil engineer was satisfied that the proper moisture content (13.5% of water by volume) had been reached.

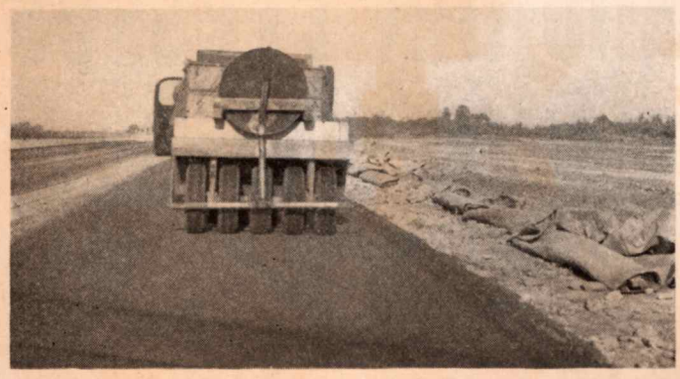
Once the cement was distributed over the sand and gravel, work proceeded on a 24-hr a day basis to speed up construction and avoid the checkerboard appearance which would be produced by interruption of work on a runway, allowing one portion to harden before the whole runway was completed. No expansion joints such as are provided in poured concrete runways are used when paving with soil-cement; hence, the checkerboard effect cannot be avoided unless the work is continuous. To carry out this night work, the contractor used batteries of flood lights mounted on portable fixtures which brightly illuminated the entire runway. The laying of the runways was accomplished with amazing speed, only eight 24-hr days being required from start to finish.

Compaction of the soil-cement mixture was accomplished through the use of what is known as a "sheep's foot" roller —a power roller fitted with closely-spaced 1″ spikes, 6″ in length. The use of this device was an important part of the soil-cement process. The "sheep's feet" initially penetrated deeply into the mixture, starting compaction from the bottom up. As they trundled up and down the runways and compaction was progressively achieved, the "sheep's feet" gradually withdrew until they virtually rested on the top of the mixture. Only about 1″ of loose mulch remained. This was scraped to true grade and rolled by a smooth-wheeled power roller to complete compaction of the last ½″ of surface. The final mechanical process consisted of "knitting" the surface tightly by means of smooth-tired pneumatic rollers built especially for this type of work. The laying of Sisolcraft (a heavy craft paper for curing cement) over the runways finished the job. This paper remained in place for 7 days after which it was removed. Ten days later, the "curing" was complete and the runways were ready for use.

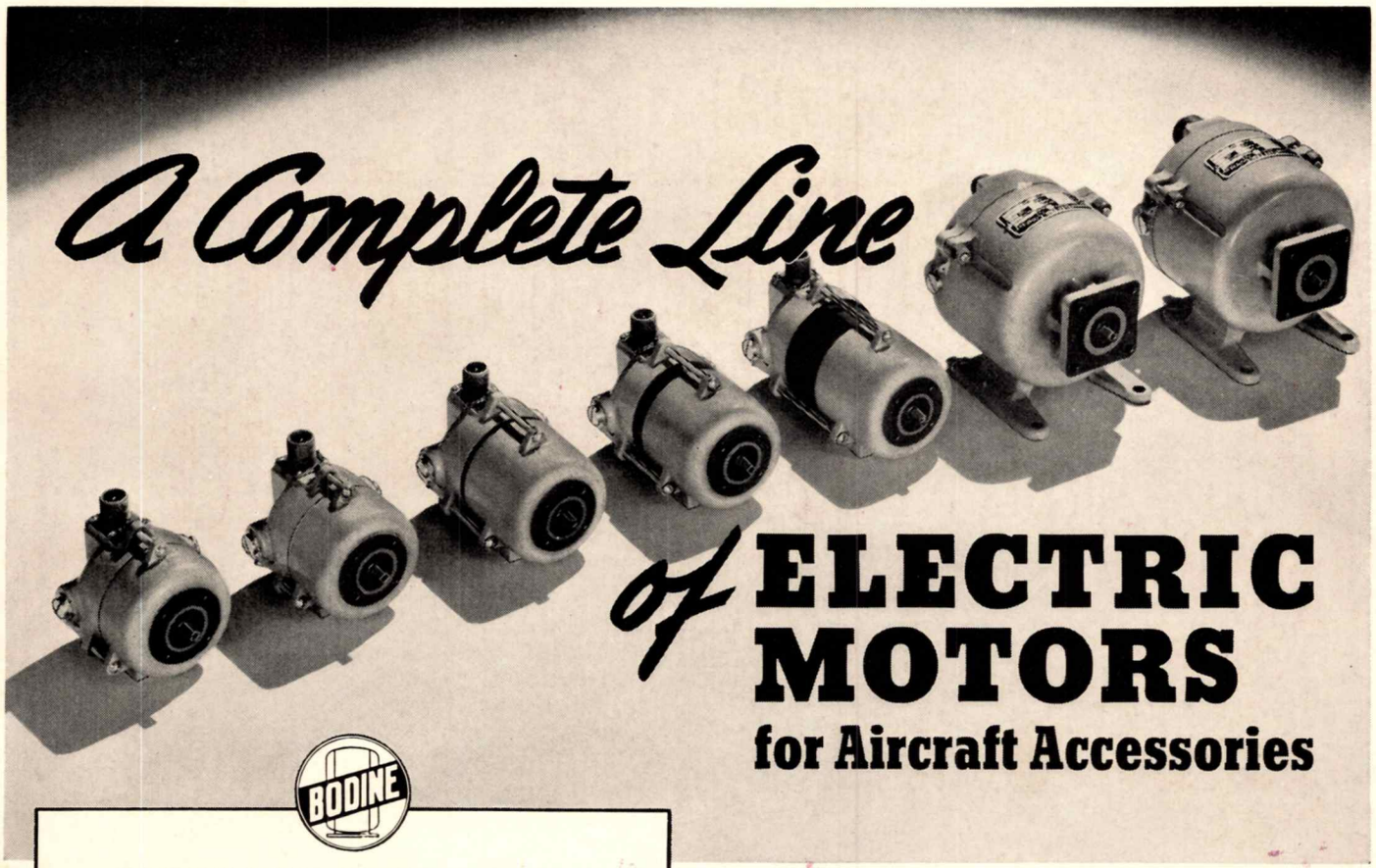
Due to the lack of expansion joints, which are not recommended where soil-cement is used, small cracks will develop in the pavement every 20 to 30 ft due to drying contraction. Approximately 95% of these anticipated cracks will appear during and after the coming winter. Accordingly, we are prepared sometime next summer to apply a seal-coat of asphalt ¼ to ½″ in thickness over each runway to provide a wearing surface and to prevent water seepage through the cracks which might cause frost heaves during the second winter. After that, we are assured we will have runway pavements which, without extraordinary maintenance, will have a life of at least 10 years.

When the first *Buccaneer* and *Bermuda* dive-bomber rolls off the line at the Johnsville plant this fall, it will find the Brewster airport, just across the road waiting to receive it. This airport we feel is another construction miracle performed under the stimulation of the national defense program, an airport built in four months at less than 50% of the normal cost of a field with hard-surfaced runways.

Rubber-tired rollers used to "knit" the surface of the completed pavement. At the right is a small rotary mixer used where larger tillers cannot operate effectively



See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



A Complete Line of ELECTRIC MOTORS for Aircraft Accessories

BODINE

AIRCRAFT MOTOR HORSEPOWER CHART

CLASS C (EXPLOSION PROOF)

SPEC. NO. 32159 (24 VOLT D. C.) **SPEC. NO. 32160 (12 VOLT D. C.)**

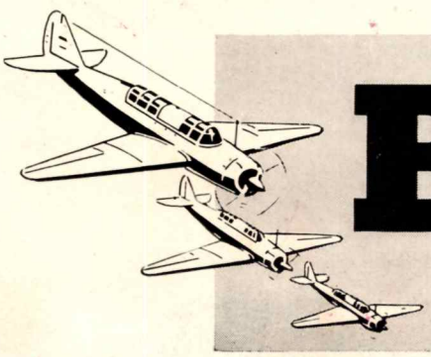
FRAME SIZE	Weight Pounds	SHUNT WOUND			SERIES WOUND		
		1125 RPM	1750 RPM	2800 RPM	3800 RPM	5800 RPM	7500 RPM
STYLE IV (MOUNTING)							
AC4-10	1.70	1/200	1/200 1/100	1/100	1/100 1/50	1/50	1/50
AC4-11	1.75	1/100	1/50	1/50	1/30	1/30	1/30
AC4-13	3.00	1/50			1/20	1/15	
AC4-14	3.40		1/30	1/30 1/20	1/15		
AC4-16	4.40	1/30	1/20	1/15	1/10		
STYLE III (MOUNTING)							
AC3-53	7.00		1/8				
AC3-535	8.08			1/5			

Bodine electric motors for aircraft accessories are available in a great range of types and sizes. All are built to Air Corps specifications and have passed Air Corps tests for explosion-proof motors. Simplicity of design and use of aluminum alloys make Bodine motors the lightest per horsepower of any available for aircraft accessories. Adequate lubrication at high temperatures is provided by special bearing construction. Self-locking nuts on the triple frame bolts have fiber inserts. All screws are wired to prevent loosening.

These motors are built to the precision standards which have been applied to the manufacture of Bodine motors for over 35 years. They are meeting defense requirements in a variety of applications and will give dependable performance in all kinds of aircraft service.

Bodine Has Been Supplying Industry with High Quality Fractional Horsepower Motors Since 1905

Bodine Electric Company, 2280 W. Ohio St., Chicago, Illinois

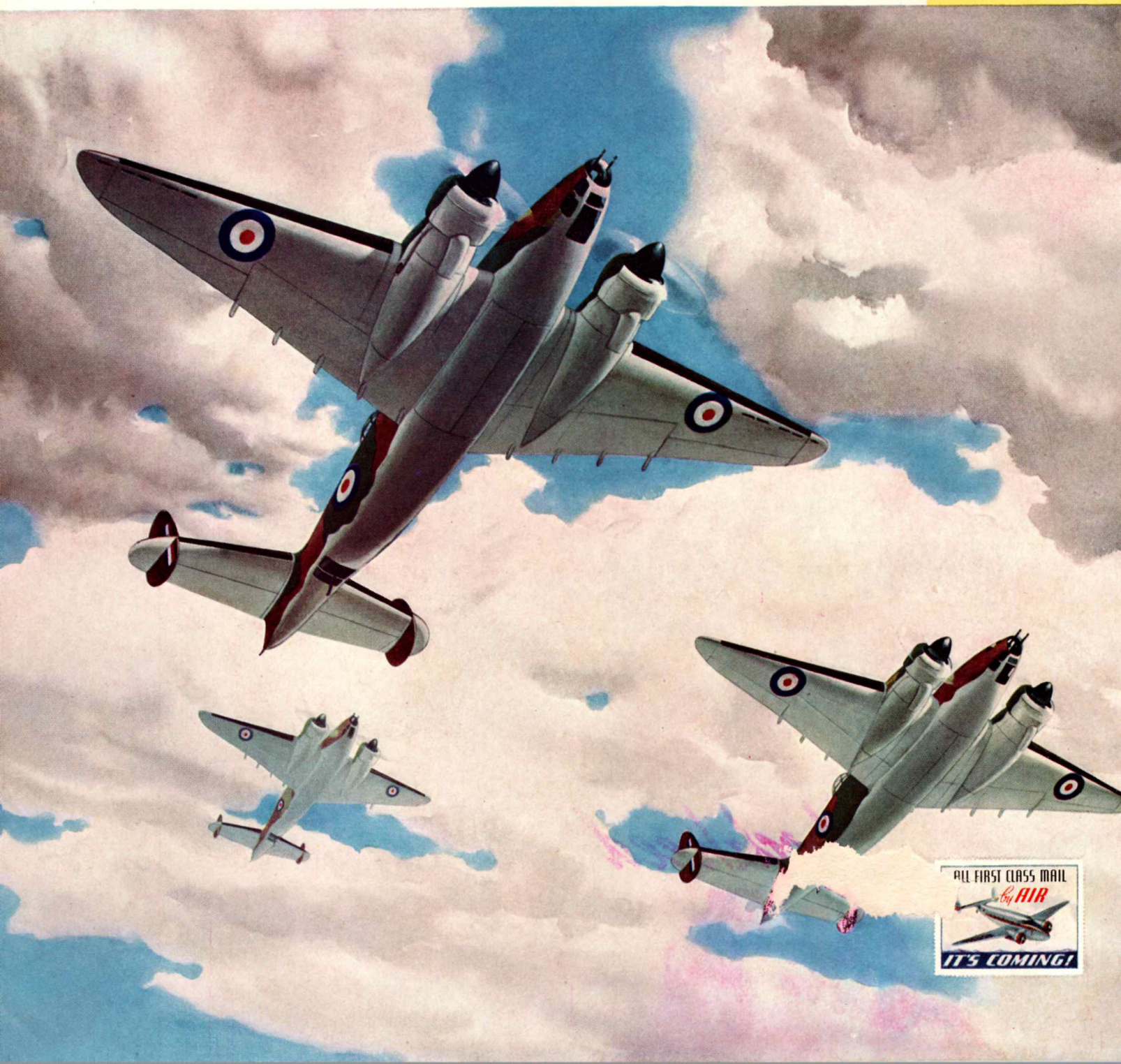


BODINE

FRACTIONAL HORSEPOWER MOTORS

THE *Lockheed* LOG

LEADERSHIP



IN PRODUCTION!

Figures available for the first half of 1941 show:

THE GREATEST DOLLAR VOLUME

LOCKHEED produced the greatest dollar volume of planes in American aviation industry.

MORE 2-ENGINE AIRPLANES

LOCKHEED produced more two-engine aircraft than any other American manufacturer...Hudson Bombers ...Lightning P-38 Interceptors and Transports.

MORE CRAFTSMEN ON PAYROLL

TODAY...Lockheed and Vega employ more craftsmen than any other organization engaged in airplane construction.

All the aircraft factories of America are working 'round the clock to meet the ever-increasing demands for more bombers, more transports and more fighters. And in this production, Lockheed leads the industry!

Because Lockheed design is sound...so sound that standard commercial airplanes like the Lockheed 14 Transport and the Lodestar become Hudson and Ventura Bombers without major structural changes...many bottlenecks of testing and retooling that have in the past hampered mass production have been by-passed.

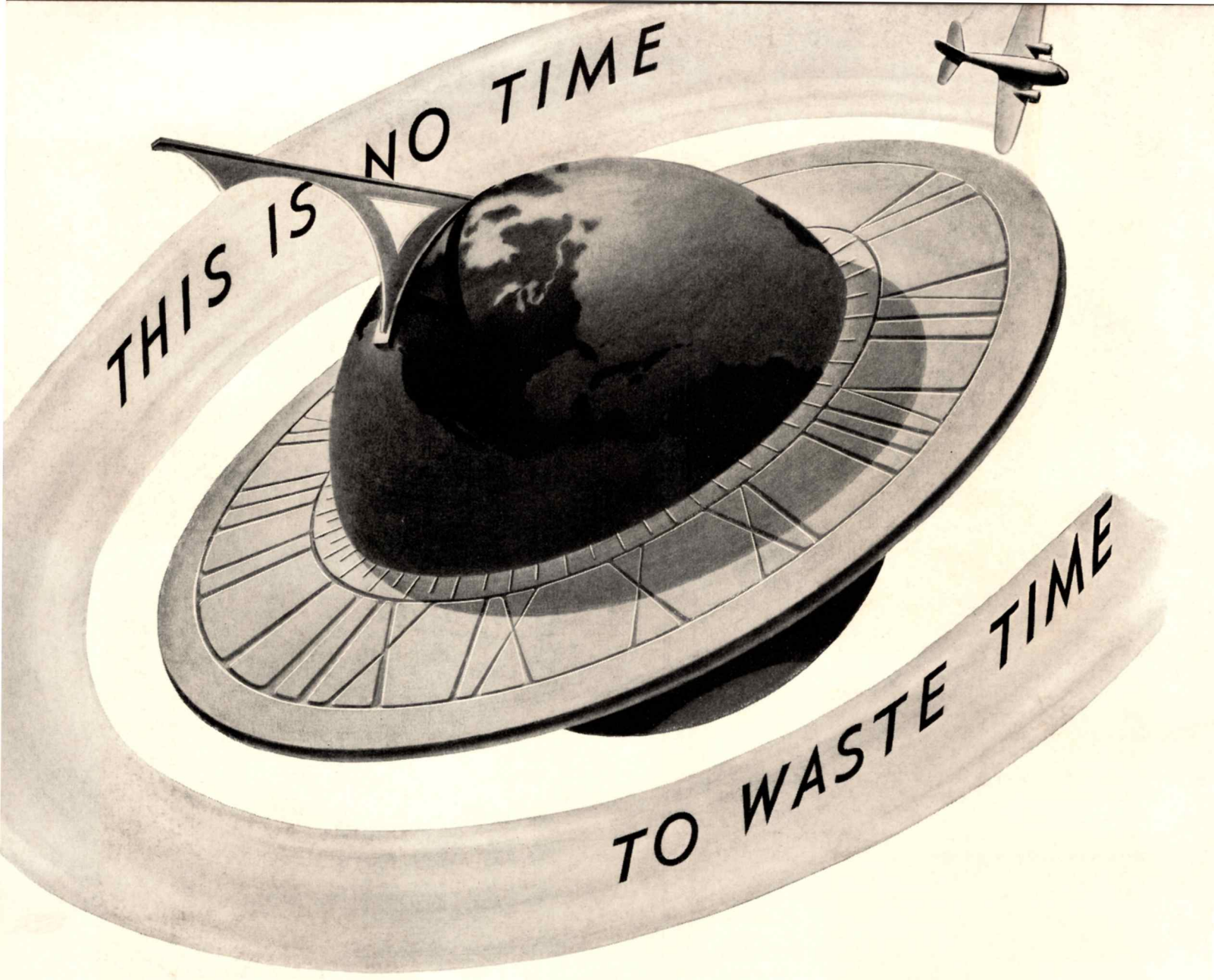
On these leadership-making designs, Lockheed aircraftsmen work in a streamlined-for-speed plant...a plant that has been designed for future as well as present production.

Thus Lockheed has been able to establish leadership in production of aircraft that lead as well in stamina, performance, reliability and public acceptance.

LOOK TO *Lockheed* FOR LEADERSHIP

LOCKHEED AIRCRAFT CORPORATION • BURBANK, CALIFORNIA, U.S.A.

Printed in U.S.A.



"THIS is no time to waste time!" is a theme recently adopted by the Air Transport Association to impress on the public the time-saving importance of flying. And who can tell for how long *speed*—of transport and production—may be vital to America's stake in civilization?

Fortunately, United States air lines are today the best in the world. They have made great strides in speed, safety and comfort. Air line passenger traffic has increased 300% in five years—totalling 2,727,820 in 1940. And, since 1929, fares per mile have been cut in half.

Defense, to which the air lines have contributed greatly, has necessarily slowed the progress of air transport. Nevertheless, planes are now in development which will carry more than 60 passengers each, and cruise with unprecedented fuel economy at speeds of approximately 300 miles per hour. They will fly regular schedules of 8½ hours between Los Angeles and New York.

"These planes," says President Jack Frye of TWA, "will give the United States leadership for years to come in air transport equipment. And lower costs, plus increasing demand for time-saving travel speed, will mean continued substantial development for the industry."

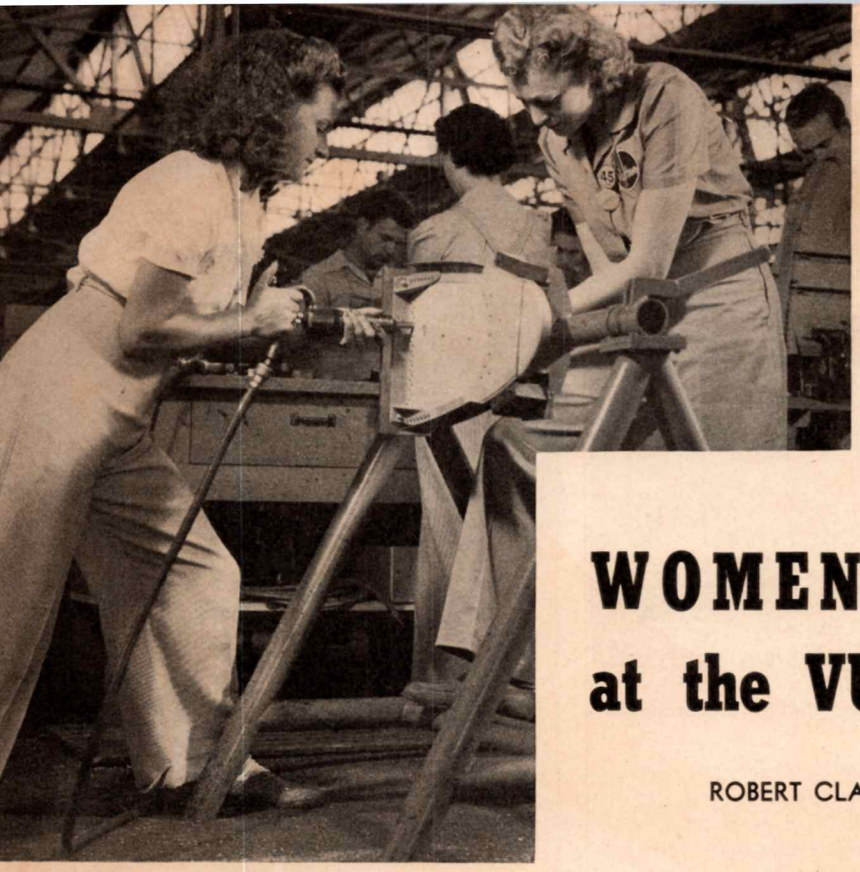
Ambitious, technically trained men will be needed, more than ever, for the operation and maintenance of the air lines.

ACADEMY OF AERONAUTICS, LaGuardia Field, New York
CASEY JONES SCHOOL OF AERONAUTICS, Newark, N. J.

COMPLETE TECHNICAL COURSES IN AERONAUTICS

C. S. Jones
President

ADVERTISEMENT NUMBER SEVEN OF A SERIES ALSO APPEARING IN TIME AND FORTUNE



Vultee girls in the wing subassembly department rivet a wing rib. At the right, a girl is welding a dilution tank in the sheet metal department

WOMEN WORKERS at the VULTEE PLANT

ROBERT CLARY

● The industry now has more than 300,000 workers, and is growing fast. So fast that some estimates put the employment leveling-off point at a million persons. If old standards and practises were followed practically all of these new workers being hired would be men. But the industry is now operating under forced draft, making every minute do the work of two, putting the right person in the right job to get maximum production in minimum time. In this new order of things, women have a real place in the aircraft factory, and it is not an uncommon sight today to see them working shoulder to shoulder with the men, toiling as skilled technicians in the mass of mechanized production of aircraft.

Today there are jobs for women in the aircraft plants. But, like their male coworkers, they must have a certain degree of skill. Unskilled labor is not being taken on in any magnitude, and women are advised to take courses in accredited private aviation schools which are best equipped by experience to offer the type of training which provides advancement opportunities. Many of the major aircraft plants have hired women and undoubtedly will even increase the ratio of women to men employees, for women are rapidly becoming an integral part in the expanding aircraft program.

At Vultee Aircraft, for instance, women long have shared the complicated duties of building aircraft. As long ago as last April, Vultee hired about 50 women and put them to work in two departments. In the Trim Department they proceeded to operate powered sewing machines on the fabric-covering of control surfaces. In the Electrical and Radio Department, they proved themselves adaptable and dexterous in connecting wires and terminals in electrical junction boxes.

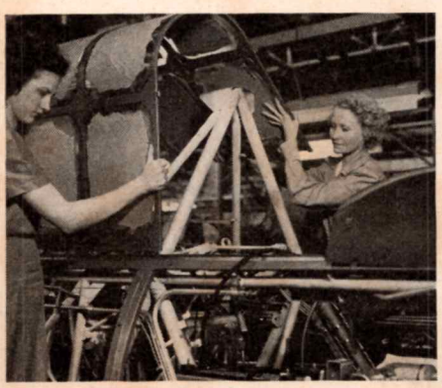
In fact, so well did women work out in these two departments, working side by side with men, that now there are more than 300 of them working full time regularly in the plant. More will undoubtedly be added, and no maximum has been set.

Of course, the company is still hiring

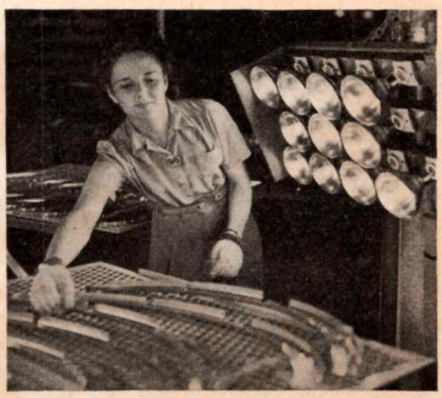
Spraying cockpit canopies

Connecting wires in junction box

Riveting in sub-assembly

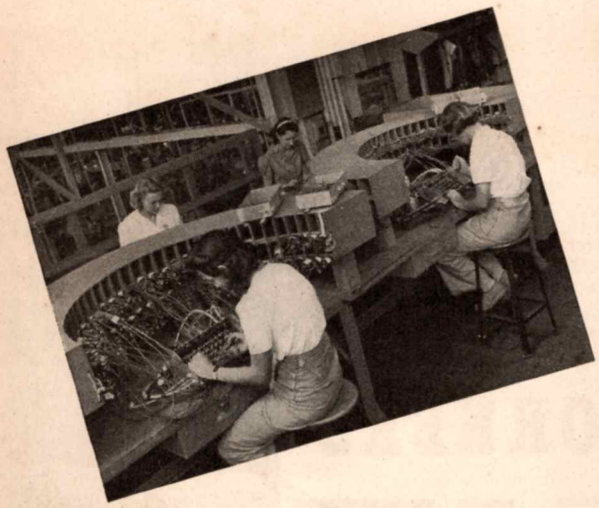


Working on final assembly

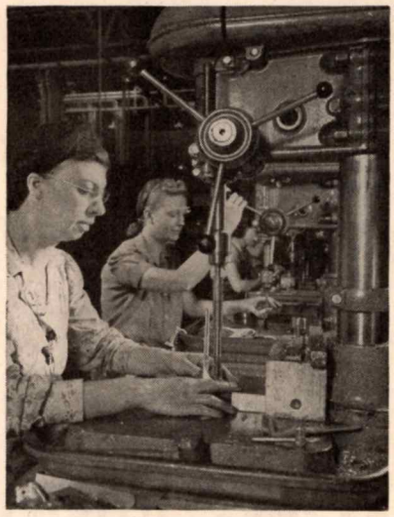


Attending the paint conveyor

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



Girls at the Vultee plant attach cables in electrical junction boxes



Women operate light drill presses

Masking operations in the paint shop are performed by women

men, but male employees are being assigned to heavier or more skilled types of work for which they are better qualified. To date, no men have been fired or replaced by women. The men who previously did the work which women are now doing have simply been transferred to more skilled or higher paid jobs in the same factory, where they always have an excellent chance to advance.

Every effort is made to limit the labor of women to light-work operations which do not overtax their energy. So far the experiment at Vultee of using women in airframe production has worked out, in general, excellently. The various foremen report that they are not only manually dexterous and invariably diligent, but that they are also exceptionally intelligent and well capable of handling a good day's work.

Perhaps that is why the rate of pay for the women is exactly the same as that for the men. A recent survey disclosed that the average hourly woman's wage at Vultee is 70½c, whereas the average hourly wage of the same women in their previous factory work elsewhere had been only 44½c.

In Vultee's case no particular training period was required, since a great many of the girls had previous factory experience. The various operations in which they work have been broken down and laid out with a sane and sound simplicity that the leadman or foreman can show them in a single day's time exactly how each job should be done.

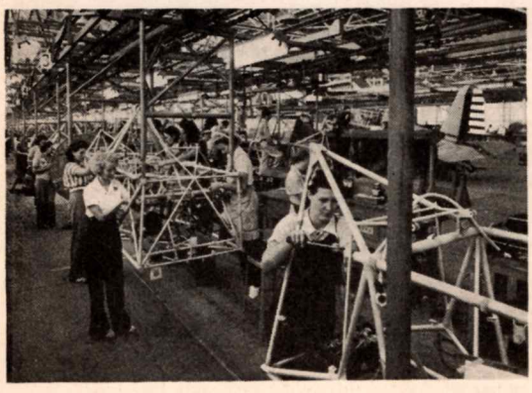
Vultee decided to hire women because of three answers: (1) women are more suitable to certain types of work because of their adroit and expert finger dexterity; (2) if real wartime conditions should develop in America, the available supply of men would inevitably be curtailed severely, and the large-scale employment of women would become mandatory. Company officials felt that they should have some actual experience in working with women in the factory before such eventuality; and (3) the company felt that women as well as men should be allowed to play a vital part in the actual operation of the national defense program.

The average Vultee girl is 27½ years old. Her age ranges from 21 to 49. Out of 286 women employees recently tabulated, 210 are married, of which some 172 have children. Of the total number, 253 had had some previous factory training, although not in aircraft. Practically all of the girls have lived in California for some time, are not migratory workers.

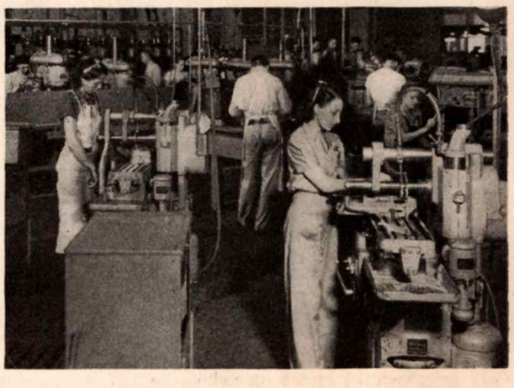
Near the factory is a special Aircraft Training School in which 48 of the girls are now studying in their spare time, taking trade extension courses which will enable them to be more efficient in their present jobs and to qualify eventually for better and higher paid jobs. This school, supported by local and federal funds, has its courses planned and laid out by Vultee, and Vultee supplies the instructors.

No special consideration has had to be given to the girls, other than providing separate restroom facilities. And the only regulation under which the girls operate is that they must wear slacks and must not wear open-toed shoes. Both of these requirements are merely safety measures, to eliminate the possibility of personal injury from dresses catching in machinery or unprotected toes being stubbed or mashed.

Vultee's experience proves conclusively that the idea of working women in aircraft production actually works. They are in the machine shop, burring and filing, operating light drill presses, doing light riveting, welding, operating milling machines. Some paint parts with high-pressure spray-guns; others inspect component parts and sub-assemblies; and still others assemble wiring in electrical junction boxes. They are even used in the important final assembly of welded tubular fuselages.



A general view of women workers on the mechanized final assembly line at the Vultee Field plant. At the right women are operating production milling machines in the machine shop



See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

"A feeling and sense of security unparalleled in our flying experience . . ."

The Brayton Flying Service, Inc., Lambert Field, St. Louis, is using two Waco UPF-7 planes for their secondary pilot training.

LET'S GO! U.S.A. · KEEP 'EM FLYING!

Speaking of the two Waco UPF-7 trainers, Chief Pilot and Instructor, James Malone, of the Brayton Flying Service, Inc., says: "After successfully graduating over 90 students in the secondary acrobatic phase of pilot training, we have ridden these ships with a feeling and sense of security unparalleled in our flying experience. In training the students in advance acrobatic maneuvers, their attempts turn out to be violent convulsions which the ship stands without a murmur. For acrobatic training, this ship is outstanding and has proved itself trustworthy and reliable."

Chief Mechanic, Harry Grow, adds: "We appreciate the wonderful cooperation of the Waco Service Department in keeping us informed of the changes and improvements made on the UPF-7 Model Waco. Their service can't be beaten."

A dependable ship backed by dependable service spells profit for the base operator who has a CPTP secondary program. Isn't this the kind of a ship you need for your secondary work?

WACO AIRPLANES

WACO AIRCRAFT COMPANY • TROY, OHIO • U.S.A.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

DIGEST of the NEWS

VASTLY ENLARGED AIR FORCE SEEN NEW BOON TO INDUSTRY

Air Arm of 500,000 Men to Require Greatest Number of Aircraft Ever Built—Production Now Over 2000 Monthly

Before he promised to call a halt to the publication of aircraft production figures because they were of use to Axis powers, President Roosevelt last month announced a vastly enlarged armament program for 1942 to give this nation and those battling the Axis a flow of military material to assure ultimate victory. Almost simultaneously, additional electrifying news broadcasts by the OPM and the War Department revealed an immense increase in the U. S. Army Air Forces and an airplane building program calling for the world's largest and most potent aerial arm.

Last official figures for American aircraft production for a single month showed that September set a new record of 1914 aircraft which was 60 better than the previous month. With production increasing steadily and impressively, monthly output of all types of military aircraft by the end of the year will be well over the 2000 mark. September results brought the total production for the first nine months of the year to 12,651, with an increasing number of these during the latter months being combat rather than trainer aircraft as was the case in earlier months this year.

Indicative of the way American aircraft production is going, but by no means official although bearing authenticity, was the opinion expressed by Col. Roy M. Jones, supervisor of procurement for the Army Air Forces in the Eastern District. Col. Jones, in an interview last month, said that by the end of 1943 American industrial production will be able to supply military aircraft at the rate of 100,000 a year and that President Roosevelt's 50,000-a-year plane program was easily within the reach of the industry. New plants now going up, Col. Jones said, are so superior to those in existence at the start of the European war that they will assure our supremacy in production over Germany, Great Britain and all foreign nations.

The full scope of what the industry already has accomplished also was revealed during the month when it was reported that in the first half of 1941 aircraft builders had surpassed their deliveries for all of 1940. Working on defense orders totaling nearly six billion dollars, the industry delivered $617,345,086 worth of airplanes, engines and propellers compared with $544,440,000 during all of last year. The report showed that on Sept. 1 the industry was employing 326,002 persons compared with 89,893 on Jan. 1, 1941 and that when the present expansion program is completed 573,806 persons will be employed. Of the total deliveries, $284,000,000 worth went to the British under Lease-Lend Authority.

500,000 Men for Air Force

Significant and highly important was the War Department announcement by Secretary Stimson that preparations were being made to expand the Army Air Forces to 400,000 pilots and enlisted men by June 30 next, and possibly to 500,000 after that date. Tripling the present strength of the air arm of the Army, the move will permit an enlarged grouping of

(Continued on page 110)

Private Plane Production Increases 65%

The effect of the CPT program on aircraft construction for elementary and secondary flight training purposes is reflected sharply in figures on domestic civil airplane production released by the Administrator of Civil Aeronautics, Donald H. Connolly.

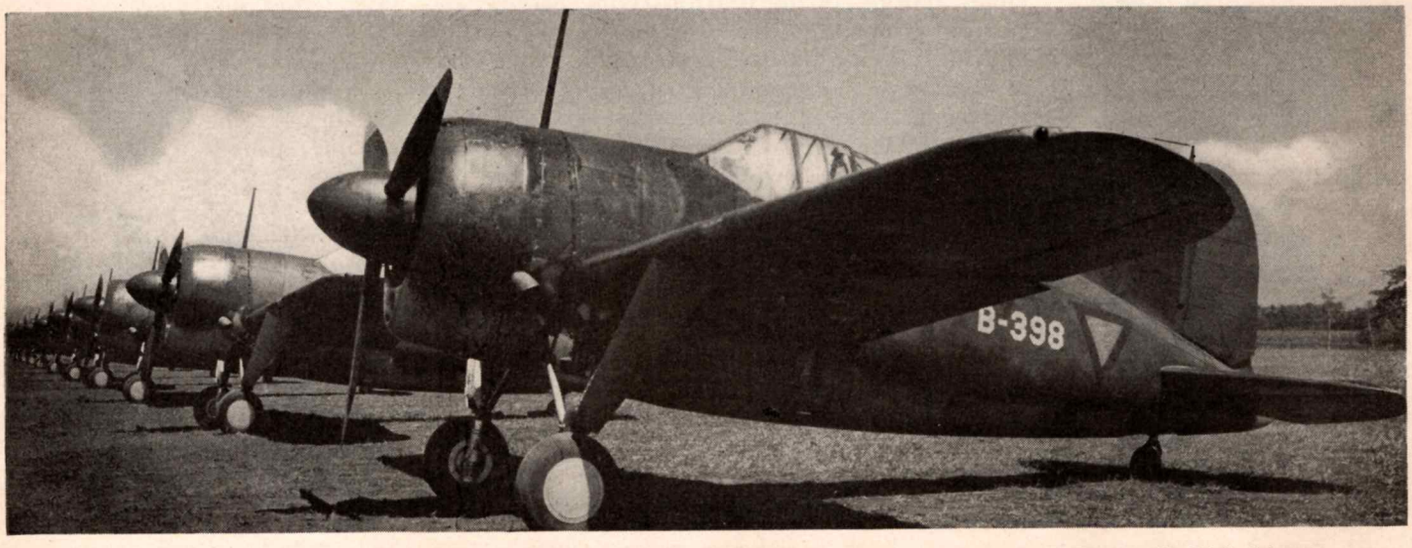
During the first six months of 1941, a total of 3775 airplanes for civilian use were produced by American manufacturers, an increase of 65% over the figure of 2289 for the corresponding six months of 1940.

Of the total, 2265 were in the 1-2-place, single engine type of from 51-70 hp, and 1113 in the 71-100 hp class.

In the single-engine 166-225 hp category, which includes aircraft used in the CPT secondary course, the production in the 1941 period was 105, against 14 in 1940. Multi-engine output in this class rose from 3 in 1940 to 25 in 1941.

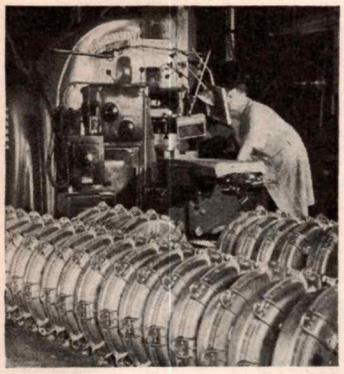
Burke Heads Permanent American Air Commission

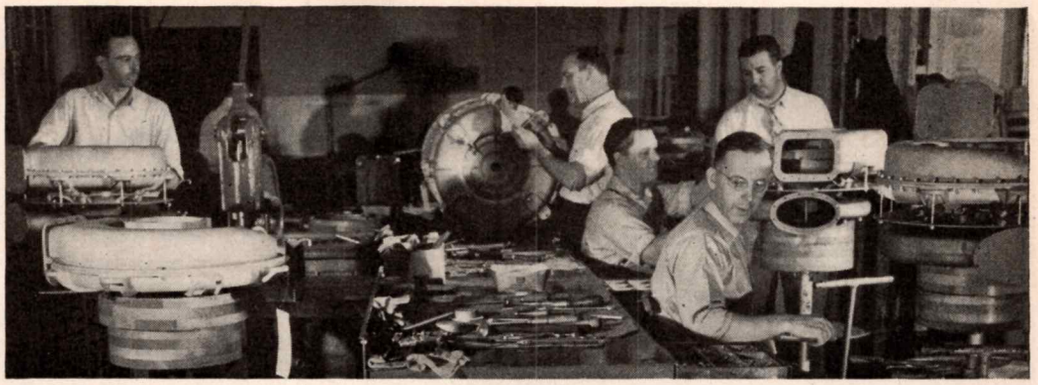
Thomas Burke, Chief, Division of International Communications, State Department, has been appointed by President Roosevelt as chairman of the United States National Commission of the Permanent American Aeronautical Com-



The Netherlands East Indies Government has added potent striking power to its Air Force by the use of the Brewster "Buffalo" fighter

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue





These views show the manufacture and inspection of impellers for turbo-superchargers at the General Electric Company plant in Schenectady, N. Y., which is making great numbers of these parts

mission which came into existence in 1937 at the Inter-American Technical Aviation Conference at Lima, Peru.

Purpose of the Commission is to advance the unification and codification of international public and private air law, and to develop technical activities in the field of aeronautics among the American republics, each of which has created a national commission to coordinate with those of the other American countries.

Other members of the United States Commission are: Reed M. Chambers (U. S. Aviation Insurance Underwriters), John C. Cooper, Jr. (Pan American Airways), Richard E. Elwell (CAA), Samuel E. Gates (CAB), Harold R. Harris (Pan-American Grace Airways), Dr. J. C. Hunsaker (MIT), Col. John H. Jouett (Aeronautical Chamber of Commerce), Dr. George Lewis (NACA), Dr. Ross A. McFarland (Harvard University), Capt. Denis Mulligan (USAC, Wright Field), Theodore P. Wright (OPM). The Executive Committee, headed by Burke, includes Elwell and Gates.

Glider Approved

Approval of the design and production facilities has been granted by the CAA on the Model BG-6 Utility Glider built by Briegleb Aircraft Co., Van Nuys, Calif. Type Certificate 6 and Production Certificate 21 were issued on the aircraft.

The Briegleb Utility Glider features the use of a set of tapered wings which are interchangeable with the standard wings which convert the Utility Glider into a soaring plane. When equipped with the tapered wings the plane is designated as the Model BG-7. This interchangeability permits the use of the plane for both primary instruction as well as advanced soaring. All basic stress and design data has been submitted to the CAA for a Type Certificate on the taper wing model, and both a Type and Production Certificate are anticipated at an early date.

Engineers' Defense Board

Establishment of the Engineers' Defense Board, a new working organization of engineers and technologists from the several national engineering societies to deal with technical problems on shortages, substitutions, conservation, raw materials, production and reclamation in the nation-wide adjustment under the impact of the defense effort, was announced in New York last month.

With an initial membership of five representatives each appointed by the governing bodies of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the Society of Autmotive Engineers, and the American Institute of Chemical Engineers, the organization will assist various branches of Government with engineering knowledge and experience on questions connected with military preparedness.

The Board will function as a clearing house for the engineering professions on information dealing with defense, particularly in relation to shortages, and through special committees will attempt improvements of standards and practices of long standing where savings of materials can be made.

The Board also will take an interest in methods for implementing the work of the advisory technical committees of the National Academy of Science and will undertake specific studies on request of the Army, Navy and official defense agencies.

Webster, CPT Head, Resigns

Grove Webster, director of the CAA's Civilian Pilot Training Service and guider of its formulation and organization, resigned last month to become associated with Southwest Airways, Inc., Phoenix, Ariz., flight contractor to the Army. Succeeding Webster is Major John P. Morris (ACR) who, for the past several months, has been CPT's assistant director. *(See photo, page 106).* Moving up to assist Morris is W. G. Stewart who has been Chief of the CAA pilot training Performance Div.

State Officials Ask Limit To Federal Encroachment

The National Association of State Aviation Officials, convening in Providence, R. I., Oct. 1-4, went on record emphatically as opposed to further encroachment on their jurisdictions.

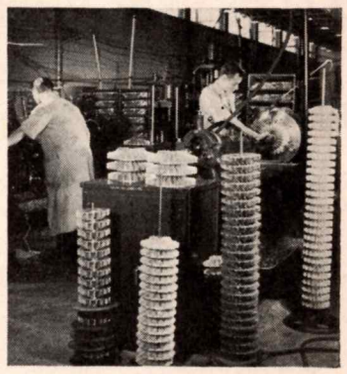
Guarding jealously their present responsibilities, they indorsed the recommendation of their legal counsel, George B. Logan, opposing proposals for Federal compulsory liability insurance on all aircraft and opposing the recommendations of the American Bar Association's Aeronautical Law Committee urging abandonment of support of the Uniform State Regulatory Act.

Logan pointed out that if the uniform act is abandoned, State officials will be abolished and a vast "training camp" for aviation officials—from which the CAA in the past has drawn its key men —will be destroyed. He said compulsory insurance would add between $1,500,000 and $1,750,000 annually, "to the cost of non-scheduled and private flying," adding:

"It does not seem that in this day and age when every possible encouragement should be given to civilian use and acceptance of planes that the time is ripe to pass such far-reaching, crippling legislation."

Oswald Ryan, member of the Civil Aeronautics Board, warned State officials to be on the alert against use of small, private airplanes by saboteurs or spies. He said:

"The 40 hp *Cub* in the hands of a skillful pilot can become as truly a menace to our defense plants and other defense facilities as the multi-engined bomber can be destructive on a larger scale.



Ways and means must be provided for meeting this danger."

Both Assistant Secretary of Commerce Robert H. Hinckley and Brig. Gen. Donald H. Connolly, CAA Administrator, assured the State officials that Federal officials will put emphasis on "development" rather than "regulation" so far as civil aviation is concerned.

Maj. A. B. McMullen, chief of the civil aviation section in the office of the Chief of the Air Forces, told the convention that military operations at civilian fields will become more and more frequent as the emergency deepens. He cautioned them that the Army will require strict control of civilian flying at such fields and that "in cases of emergency, the Army will take full control."

Pressed to define such "emergencies," Major McMullen said they would be "obvious" when they arise, and appeals for "full cooperation" from civilian officials.

The Association elected Asa Roundtree, Jr., State Director of Aeronautics in Alabama as its president, to succeed Dexter C. Martin of Columbia, South Carolina.

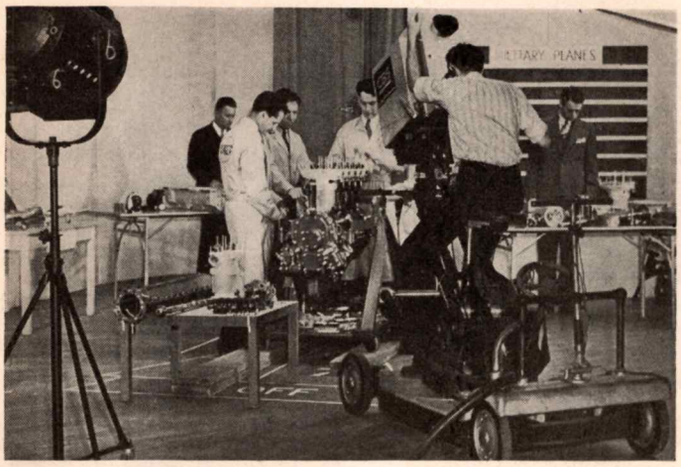
Other officers elected were:

First vice-president — Al. H. Near, superintendent of Bowman Field, Louisville, Ky.

Second vice-president—L. G. Devaney, director of Oregon State Aeronautics Board.

Third vice-president — Earle Johnson, Ohio Director of Aeronautics.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



Televising the assembly of a Ranger in-line, air-cooled engine

Televise Ranger Assembly

The Ranger in-line air cooled engine of the Fairchild Engine and Airplane Corp. made its debut before the television cameras of Columbia Broadcasting System last month in a 45 min telecast under the direction of Gilbert Seldes.

A complete engine and parts were brought in from the Farmingdale factory to the studios in Grand Central Station. Four experts from the assembly line at Ranger assembled the engine from the point at which the last cylinder was installed to final timing and installation of a test club.

Meanwhile under questions from Bob Edge and Paul Talbot of the CBS staff, Duncan B. Cox, vice-president and general manager at Ranger, A. T. Gregory, chief engineer, C. E. Carrigan, laboratory chief, and M. V. Little, chief of purchasing, described the engine's cooling, its triple damped crankshaft and damped camshaft without pushrods, while showing the various parts before the cameras.

New DeLuxe Piper Cruiser

A revised version of the Piper Cruiser, largest ship of the Piper line, was announced recently by Piper Aircraft Corp. to meet the growing need of a low cost three-place private owner airplane.

While primarily the same airplane as the Piper *Cruiser* which has been used by airport operators and flying schools throughout the country for the past few years, the new *DeLuxe Cruiser* has been improved in appearance and comfort for the private owner. Most noticeable improvement is the two-tone paint design which features a hand-rubbed finish. Interior upholstery matches the outside color scheme and deeper cushions are provided. The two-tone instrument panel with custom built instruments blends with the general color design.

Standard equipment includes dual ignition, engine starter, oil radiator, parking brake, dual hydraulic brakes, dual controls, navigation lights, battery, full swivel tail wheel, 4 ply tires and compass. The ship is powered with either the Continental 75 or the geared Lycoming 75 hp engines. Fuel capacity is 25 gal giving the ship a cruising range of slightly more than 450 miles.

Chicago Pneumatic Gets Plane Parts Contract

Contract for the manufacture of 500 sets of hydraulic cylinders to be used on Martin B-26B bombers was placed recently with the Chicago Pneumatic Tool Co., New York.

A number of different units make up one set of cylinders used on each of the twin-engined bombers. These cylinders, hydraulically operated by pressure pump, are used to actuate bomb bay doors, landing flaps, retractable nose and tail wheels, and other mechanisms.

Recently, Chicago Pneumatic Tool Co. acquired a new plant at Garfield, N. J. expressly for the manufacture of hydraulic equipment for aircraft.

The new Continental- or Lycoming-powered Piper deluxe "Cruiser"

Boutelle Made Acting Manager at Fairchild

Richard S. Boutelle has been appointed acting general manager of the Fairchild Aircraft Division at Hagerstown, following the sudden death on Sept. 1 of F. A. Galligan, who had been a vice-president of the corporation and general manager at Hagerstown for four years.

Boutelle was relieved of active duty in the office of the Chief of Air Corps last March to assist in the tremendously expanded program of manufacturing the PT-19 primary trainer for the Army. He has also been active in the initiation at Hagerstown of new developments for the Army and in production of the Fairchild 24 cabin monoplane for British personnel ferry service and of trainers for the Norwegian, Canadian and several South American air forces.

Before going on active duty with the Army he had been Director of Safety Regulation for the CAA, Director of Aeronautics for the State of Tennessee and active in aviation since he joined the Air Corps as a cadet in 1917. After the war he was in the Flight Test Section of the Engineering Division at McCook Field for several years. *(See photo, page 106).*

Northrop Re-elects Officers

When stockholders of Northrop Aircraft, Inc., held their second annual meeting last month seven former and two new directors were elected for the coming year. A report of the past years' operations also was given.

The two new directors are T. C. Coleman, vice-president in charge of sales for the company, and Graham L. Sterling, Jr.

Directors re-elected include: LaMotte T. Cohu, chairman; John K. Northrop, president: Gage H. Irving, vice-president; Moye W. Stephens, secretary; B. P. Lester; Henry Wallace Cohu; and Roland L. O'Brian.

New Distributors

Wickes Simplex blue printing machines are now being distributed in the New York metropolitan district by the John R. Cassell Co., Inc., 110 West 42 St.

* * *

Appointment of Eccles & Davies Machinery Co., 1910 Santa Fe Ave., Los Angeles, as agents for Kent-Owens Power Milling Machines in that territory was announced last month.

* * *

Appointment of Edward D. Maitby Co. as Southern California distributor for Tinnerman Products, Inc., Cleveland, was recently announced. Thomas O. Dahlstrand, factory representative of Tinnerman, will make his headquarters with Maitby for at least a year to supervise industrial application and servicing of the entire line of Speed-Nut products made by his company.

Martin Housing Project Open

During the past few weeks nearly 1200 workers of The Glenn L. Martin Co. have been established in living quarters that are located within easy walking distance of the plant where more than 25,000 persons are now employed.

These housing communities fall into three entirely different categories as to type of construction.

First, is a village of 300 prefabricated permanent homes, in the low rent range of an average of $30 to $35 per month. Second, a group of five T-shaped, one-story wooden dormitories, somewhat similar to army barracks, was built by the Farm Security Administration to provide sleeping, recreational and sanitary facilities for 300 bachelor workers. Authorities have tried to arrange that the occupants of each dormitory should be workers who are employed on the same shift so that there would be the least possible disturbance of their rest periods.

Immediately adjacent to the dormitories is a community of 200 trailers provided by the Farm Security Administration as emergency housing for additional workers and their families.

Boeing Hires 10,000

Ten thousand new employees in ten weeks is the hiring record hung up by the Personnel Departcent of the Boeing Aircraft Company in Seattle, where more than 21,000 persons, an all-time high, are now at work on the production of two types of bombing planes.

The unprecedented hiring splurge took place as work on a huge fleet of new-type B-17E Flying Fortresses emerged from the parts manufacturing stage into major sub-assembly and final assembly stages. Deliveries of the new bombers began the latter part of September. Meanwhile, an increasing rate of deliveries of Douglas-type Boston III attack bombers for the RAF also absorbed a portion of the new employment quota.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

HIS FIRST SOLO

. . and B. F. Goodrich goes along to help him!

YOU need more than a handful of confidence when you "take her up" for the first time alone. You need the feel of a sound ship, well equipped. That's why so many first flights are being made in *Piper* ships. And that's why *Piper*—as well as many other light ships and trainers—equips with B. F. Goodrich Silvertown Airplane tires and B. F. Goodrich E. T.* Brakes.

These tires help make take-offs and landings smoother, safer. When fields are wet and muddy, they reduce skid. They stay safe with fewer inflations, too.

You'll find Silvertowns doing the same thing for the big ships. Commercial airliners, bombers, fighters, are making their "three points" on Silvertowns. They're stopping smoother and safer with B. F. Goodrich E. T.* Brakes, too.

Today fifty different products from the B. F. Goodrich laboratories are helping the industry attain its goal of "More miles with more safety." These include B. F. Goodrich De-Icers and the Spinner and Slinger Ring assembly that bathes propellers in an ice-defying solution. For more complete information get in touch, by air mail, with The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

• • •

*Goodrich Expander Tube Brakes are manufactured under license and sold by Hayes Industries, Inc., Jackson, Mich., and Bendix Aviation Corp., South Bend, Ind.

LET'S GO! U.S.A. · KEEP 'EM FLYING!

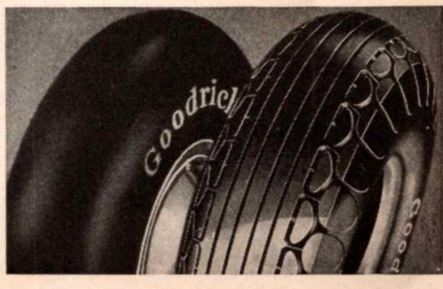
Fly with

B.F. Goodrich

FIRST IN RUBBER

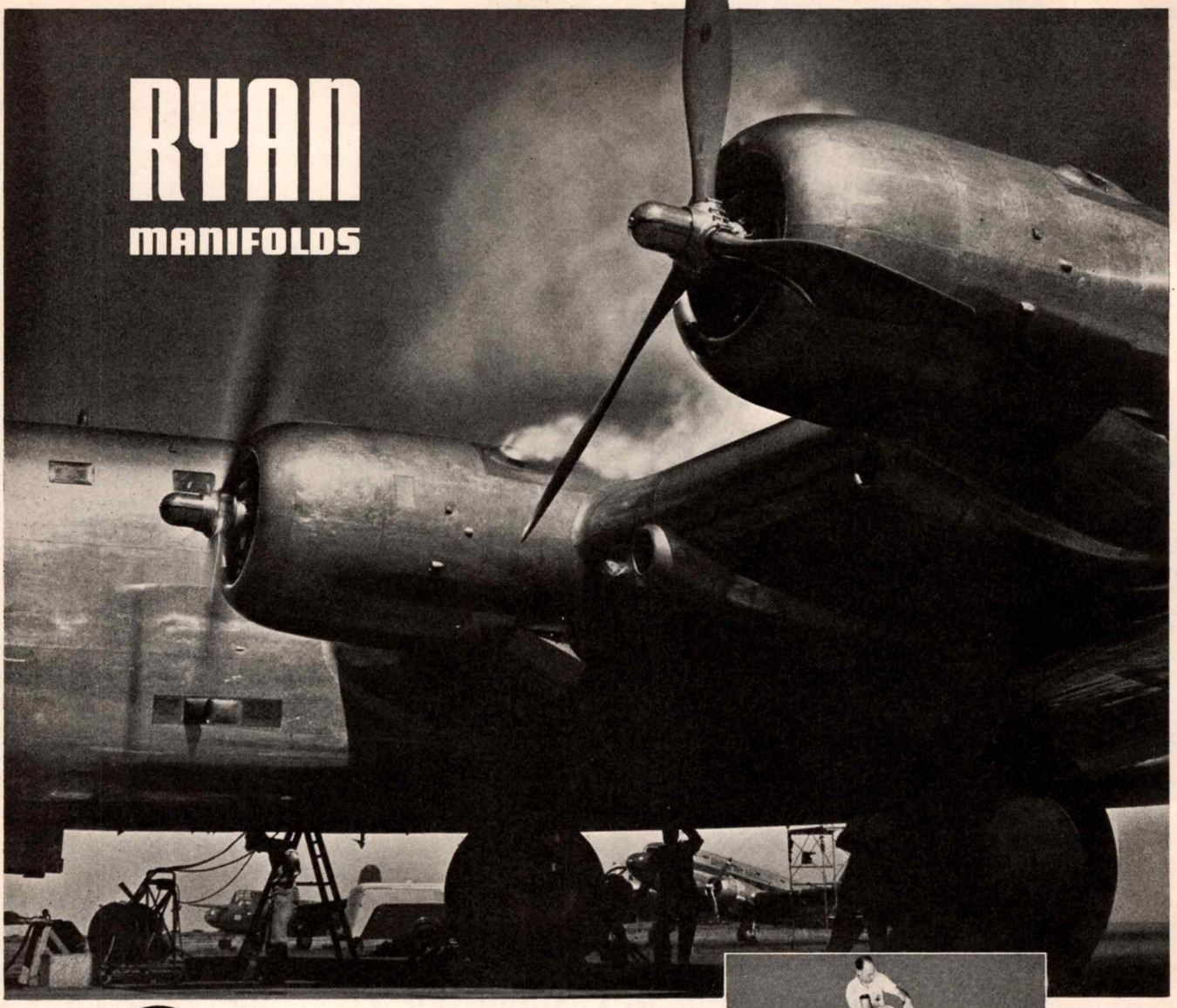
B.F. Goodrich *Airplane* **Silvertowns**

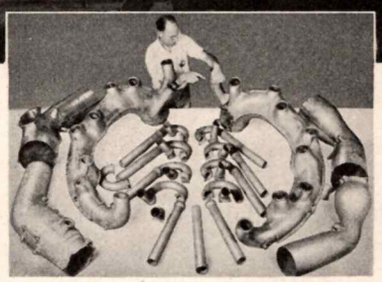
THE SAFEST AIRPLANE TIRES EVER BUILT



ER 50 RUBBER PRODUCTS FOR AIRPLANES INCLUDING TIRES · TAIL WHEELS · ABRASION SHOES · DE-ICERS · MATTING · RUBBER HOSE · GROMMETS · SHOCK ABSORBER CORD

SPECIFIED BY DOUGLAS FOR THE B-19 BOMBER





Kronquist Photo

Not the bones of a pre-historic monster but the various parts of a Ryan Universal Joint Manifold for the B-19

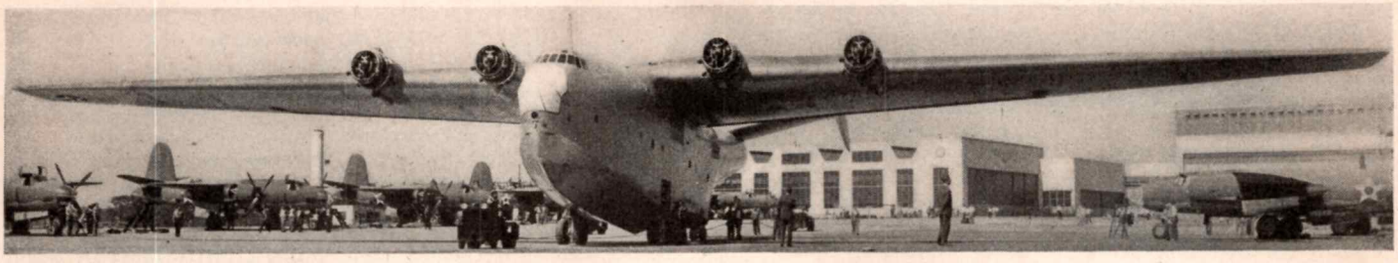
Ryan

TO PRODUCE exhaust manifolds that will hold the fire of 8,000 horse power on sustained military missions of 7,000 miles and more was just part of the assignment filled by Ryan in supplying collector rings for the Douglas B-19, "Guardian of a Hemisphere." Other engineering requirements dictated Universal Joint Manifolds, developed by Ryan over three years ago, and on which U.S. Patent No. 2,219,752 has been issued. Ryan feels honored in having been selected to develop the world's largest exhaust manifolds for the world's largest bomber. ¶ Your exhaust collector ring needs may not call for so huge an installation as on the B-19, still the problems involved may be even more intricate. If so, you too can benefit by Ryan engineering experience and production facilities. Ryan produces *all* types of exhaust manifolds to meet *any* requirement. We are producing at three times the volume of a year ago, and making deliveries in advance of customer's needs. Yet, recently expanded facilities assure capacity for a large additional volume of exhaust manifold business. Your and our engineers should get together.

RYAN AERONAUTICAL CO., LINDBERGH FIELD, SAN DIEGO, CALIF.

Builders of Famous Ryan S-T Trainers

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



View of the new Martin XPB2M-1 flying boat as it emerged from the Baltimore factory last month for the first time

CAA Instructor and Pilot Training for Defense Gains

Flight instructors are being turned out by the CAA pilot training program at almost double the best previous rate, while the number of student pilot graduates entering the Army and Navy continues to increase.

Significant also was the report that two-thirds of the American Eagle Squadron in England learned to fly in the Civil Aeronautics Administration's pilot training program. This word was received by the CAA from Pilot Officer Harold Strickland, a Chicagoan now stationed at London as a member of the American Eagle Squadron, R.A.F., who said most of these men had soloed only about a year ago.

Flight instructors have been going to the Army, Navy, Canadian Air Force, and the airlines at the rate of 216 a month since June 1, as compared with the three-month average of only 112 a month previous to June 1. CAA student pilots have been answering defense calls at the rate of 916 a month since the first of June, well ahead of the previous three-month average of 863. A grand total of 12,079 students and instructors have joined the defense effort since the CAA pilot-training program began.

The instructors are all CAA-trained students who have gone through the elementary, secondary, cross-country and instructor classes of the program and who are now working either at the civilian schools where the Air Corps is having cadets trained, at schools of the Canadian Air Force, as active members of U. S. Air Corps and Navy forces, or as co-pilots on the nation's airlines. Most of these last replace airline pilots who have been called to the colors.

Vanguards for China

Newest version of the Vultee *Vanguard* pursuit is now being manufactured in quantity for China, and a number of them, designated the P-66, already have been completed.

The *Vanguard* has been on order for the RAF, but due to the need of China for fast, high-flying pursuit planes, the British have agreed to release the plane.

The new *Vanguards* now rolling off a special assembly line embody latest developments in the *Vanguard* line, which came into prominence a year and a half ago. The airplane is a low-wing monoplane, powered with a 1200 hp Pratt & Whitney engine, giving a reported speed in excess of 350 mph.

Expansions

Additional plant expansions announced last month were as follows:

AIRCOOLED MOTORS: — A new building at Syracuse, N. Y., to centralize and coordinate engineering activities and permit the space now taken by the engine ring department to be used for production and assembly; the structure will house drafting room, engineering vault, dynamometer room, test cells and equipment.

SOUTHERN AIRCRAFTS — $248,794 has been obtained from the Defense Plant Corp., for additional land, building space and machinery for expansion at Garland, Tex., where subcontracting work is being conducted for major aircraft manufacturers.

DOUGLAS:—Hardly had the Long Beach buildings been completed when the company announced a $13,000,000 program to double its size and production capacity. The new buildings will bring working area to 2,750,000 sq ft and increase total cost of the project to $25,000,000. New units to be added to the eleven now operating will include an engineering building, two subassembly and one final assembly structures, a mill building, maintenance building and an addition to the receiving unit.

JACOBS:—Now engaged in building engines for the U. S. and the Canadian government, the company will erect a $13,000,000 structure at Pottstown, Pa., in which it will build P & W engines under license for the U. S. War Department.

NORTH AMERICAN: — The large bomber assembly plant now beginning operations at Kansas City, Kans., will be formally dedicated Jan. 10-11. The plant will employ 10,000 persons when it is operating at peak capacity. It cost $10,000,000.

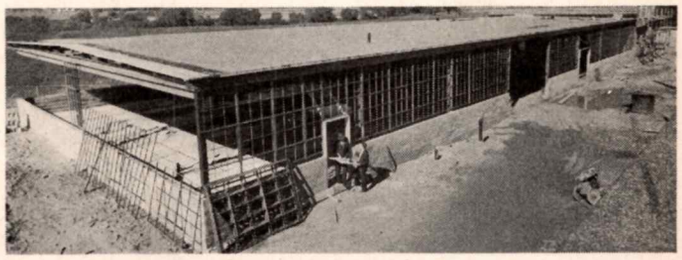
P&W:—Three more additions will be made to the E. Hartford plant, and work already has started on a two-story engineering building and two additional test houses. When the work is completed, the company will be operating 2,100,000 sq ft of engine production space. Present production is 1,600,000 hp a month: this will be increased to 1,800,000 hp by January, 2,000,000 by July, 1942 and 2,800,000 by July, 1943.

BELL:—Construction of an addition to the Niagara Falls plant, more than triple the size of the present plant there, is under way. The addition is expected to be completed by the Spring.

TIMM:—Purchase of 54 acres of land immediately adjacent to the Los Angeles Metropolitan Airport was announced last month. Included in the proposed plan is an airport with a 1600 ft runway.

ALUMINUM CO. OF AMERICA: — A second blooming mill will be built at Massena, N. Y. for the manufacture of forgings for aircraft engines and fittings and rod, bar and wire for national defense industries. Costing in excess of $15,000,000 the addition will have more than 450,000 sq ft of floor

The new Reynolds Metals aluminum plant at Longview, Wash.



Finishing touches on Franklin's new engineering building, Syracuse

General view of the Graham-Paige machine shop in Detroit where aircraft and marine engine parts are made

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

space including a new melting department.

REYNOLDS METALS:—Plans are being drawn for the third aluminum plant owned and operated by the company. It will be located at Listerhill, Ala., where Reynolds already owns an alumina plant and an aluminum plant producing 40,000,000 lb of virgin aluminum a year.

PLOMB TOOL: — A large building adjacent to its main office and factory in Los Angeles has been leased to ease crowded conditions in the stock department.

LITTELFUSE, INC.: — A new plant has been opened at El Monte, Calif., supplementing the factory in Chicago. The new addition has 21,000 sq ft of floor space and will employ 200 persons, with production particularly intended for the aircraft industry.

GENERAL ELECTRIC: — Two additional plants for the exclusive manufacture of turbo-superchargers are now being built; they will add more than 500,000 sq ft of floor space at Schenectady.

ROCHESTER ROPES:—A new plant has been opened at Culpeper, Va. Working since July 1, the plant is devoted entirely to defense work and to meet demands for all types of wire rope and cables. The plant is being operated as a branch of the Jamaica, N. Y., factory where the main offices of the company are located. Becky Havens recently was appointed the company's Eastern Sales Representative for the aircraft industry.

Training Safety Record Set

A tremendous advance to 16,194,000 miles flown per fatality in the pilot training program of the Civil Aeronautics Administration during the three months ended August 15 was announced last month by Administrator Donald H. Connolly. It compares with 8,252,000 miles for the previous three months.

In the whole program prior to February 15, 1941, the figure was 4,500,000 miles flown per fatality. Between February 15 and May 15, the figure rose to 8,252,000 miles, and between May 15 and August 15, to 16,194,000 miles.

From the beginning of the program in the Spring of 1939 to August 15, 1941, the overall figure is 6,400,000 miles flown per fatality.

To safeguard this amazing safety record, CAA officials are now holding hundreds of nationwide conferences on safe flying practices.

In a recent series of such conferences in Region Six, which includes California, Nevada, Utah and Arizona, dozens of ideas were produced for improving still further the record.

These range from a radical change in the teaching schedule to the simple fining of a student for failure to look around before making a turn in the air. Principal need, according to most of the flying school heads, instructors and coordinators who took part in the conferences, is for better understanding of the traffic pattern about each airport by student fliers, and more alertness on the part of instructors in simulated forced landings.

NAA Directors Meet

Members of the board of directors of the NAA met in Detroit last month for their fall meeting, the first ever held outside of Washington, D. C., national headquarters.

Gill Robb Wilson, NAA president, was the speaker at a joint luncheon of the Rotary Club and the Detroit chapter of the NAA, following the morning business session of the board.

William B. Stout, president of Stout Skycraft Corp., and a vice-president of the Detroit chapter, shared the program.

Following the lunch, the 20 members of the board visited defense production activities of the Ford Motor Co., following which they were guests at an informal reception at the Book-Cadillac Hotel in the evening. The next quarterly meeting of the board will be held in Miami.

Pilots, Planes Increase

The number of certificated pilots in the United States reached a total of 91,442 on Oct. 1, according to Administrator Donald H. Connolly of the CAA.

This is more than double the 44,000 licensed pilots on record with the CAA as of October 1, 1940. The bulk of the 107.8% increase is accounted for by the CAA pilot training program, which graduated over 31,000 new pilots during this period and currently has more than 8000 trainees in elementary courses.

Classified by grade, there are 75,411 private pilots, 14,437 holding commercial or limited commercial certificates, and 1594 licensed as airline transport pilots.

Civil aircraft holding CAA certificates of airworthiness increased 55% from 15,200 on Oct. 1, 1940, to 23,496 on Oct. 1 of this year.

United Expands Wire Network

As a further aid in handling peak operations, United Air Lines has added another 1000 miles of wires to its ground communications system, bringing it to a total of 10,000 miles in length as the world's largest automatic private wire network of any transportation company.

Latest extension of United's ground wires has been on the Pacific Northwest section of the company's coast-to-coast route, giving such cities as Boise, Pendleton, Walla Walla, Spokane and Portland facilities for direct and speedy communications with other points all along United's transcontinental and Pacific Coast system. Supplementing two-way radio communication between planes and ground stations, the surface communications lines are employed for operations messages, reservations requests and other company business.

Experts to Get Army Posts Under New Law

A law enacted and approved late in September authorizes the President to appoint qualified persons, who may serve as experts and specialists, to commissions as officers in the Army without specific designation to any particular component of the Army. The President may make appointments only for the duration of the emergency and for six months thereafter in any grade under that of Brigadier-General. These specialist officers receive the same pay and allowances and grades as Officers of the Reserve Corps. Apparently the law permits appointments regardless of age and of limitations that would otherwise keep men out of the Army.

Several appointments have already been made for special service in the Air Corps.

More Light Planes Ordered

Aeronca YO-58 and Piper YO-59, both recently tested by Army Air Forces at Wright Field, have been purchased by the War Department in two contracts. Aeronca received an order totalling $11,328, and Piper for $12,492.

These ships, as well as the Taylorcraft YO-57, are designed for use as liaison craft with ground forces. They all are 2-place, high wing monoplanes, powered by a 4-cylinder 65 hp Continental engine and equipped with two-way radio.

Luscombe Flown to Panama

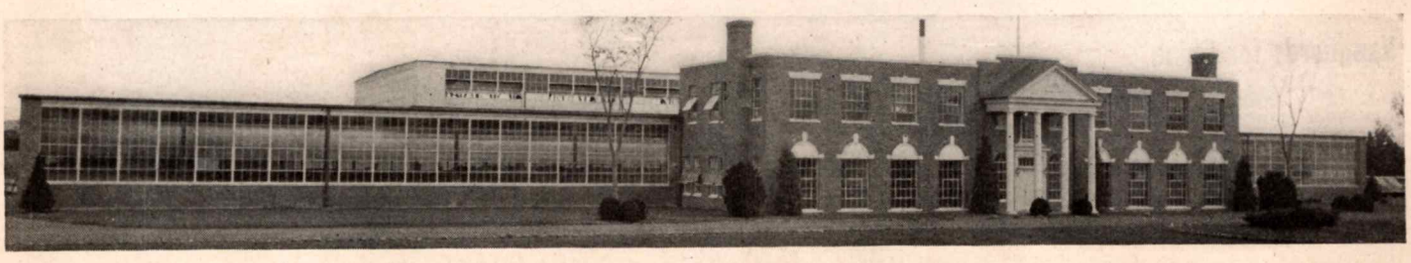
A Luscombe *Silvaire Master* powered by a 65 hp Continental was recently flown to Panama City from West Trenton, N. J., by Naron H. Lee, U. S. Army Air Corps. Purchased by Capt. Marcos A. Gelabert, Chief Training Officer of the Panama Air Corps, the ship is to be used for flight training of Panama police and government officials. It is equipped with an extra fuel tank and a full set of instruments for blind flying instruction.

Lee flew from West Trenton to Brownsville, Tex., then to Panama City *via* Tampico, Vera Cruz, Minatitlan, Tapachula, Guatemala City, San Salvador, Managua, San Jose and David.

C-W Tech Contract Renewed

Training of Army Air Corps mechanics at Curtiss-Wright Technical Institute, Glendale, Calif., which has been in progress since August, 1939, will be continued during the coming year under a new contract awarded the school, of which Major C. C. Moseley, is president.

During the coming year, 702 enlisted men from various Air Corps fields will be sent to Glendale for 880 hours' instruction as master aviation mechanics.



This new building at Culpeper, Va., is now busily engaged in producing Rochester wire rope and cable for national defense

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

THREE crowded assembly lines of twin-engine, all-metal BEECHCRAFTS show the results of one year's expansion for Defense production at the Beech factory.

These results are further apparent in the following comparisons of production and related activities at Beech for October 1st, 1940 and October 1st, 1941:

Deliveries during September 1941	702% of September 1940 deliveries
Inventories of raw materials and work in process October 1st, 1941	670% of October 1st, 1940
Total available floor area	550% of October 1st, 1940
Total employees	403% of October 1st, 1940
Backlog of uncompleted work	390% of October 1st, 1940

Deliveries for the company's fiscal year 1941, which ended September 30th, are 430% of deliveries for fiscal 1940, after adjustment to a common basis. September 1941 deliveries alone are practically equivalent to total deliveries for the 1940 fiscal year, allowing for the value of engines and equipment furnished by the Beech Aircraft Corporation during 1940, and not thus furnished during 1941

The much larger percentages of increase in deliveries and inventories than in floor space and total employees show the attainment of increased operating efficiency. Further increases in efficiency are within immediate reach, as the result of a continuous employee training and upgrading program. Present production is as yet only a fraction of the ultimate planned production level, which should be reached by March 1942. Unfilled orders on hand now total approximately 88 million dollars.

Information regarding all commercial BEECHCRAFTS known to be on the market is available from the Used BEECHCRAFT Exchange, a service maintained for the benefit of present and prospective BEECHCRAFT owners.

LET'S GO! U.S.A. · KEEP 'EM FLYING!

Beechcraft

BEECH AIRCRAFT CORPORATION

BEECH AIRPORT . WICHITA, KANSAS, U.S.A.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

The Profile with a Point!

Every Allison-powered U. S. Army fighter is distinguished by the slender pointed nose you see in the picture below—the nose that helps make them as swift and agile in action as they look.

And this they've proved in the toughest test of all—in actual combat with the RAF—as you read in the news from the fighting front day after day.

But that's not the only good news about this advanced liquid-cooled engine. Thanks to the cooperative energy of our Army and aircraft industry, it's now moving from production lines to planes in ever increasing quantities month by month.

LET'S GO! U.S.A. KEEP 'EM FLYING!

IN THE FRONT OF OUR AIR DEFENSE

★ ★ ★ *Powered by Allison* ★ ★ ★

PLANE MANUFACTURER	AMERICAN DESIGNATION	BRITISH DESIGNATION
Bell	*Airacobra*	*Airacobra*
Curtiss	*P-40*	*Tomahawk*
Lockheed	*P-38 Interceptor*	*Lightning*
North American	*Apache*	*Mustang*

LIQUID-COOLED AIRCRAFT ENGINES

Allison

DIVISION OF GENERAL MOTORS

GM GENERAL MOTORS

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

AT THE AIRPORTS

New Airports

Construction of a $2,000,000 Jefferson County airport midway between Port Arthur and Beaumont in Texas began last month when county and city officials took part in ground-breaking ceremonies at the site.

The airport is being financed with an $800,000 county bond issue and the remainder in federal funds. It is situated on an 800-acre tract and its concrete runways will accommodate the largest airplanes now being built.

* * *

Announcement has been made that the Dallas City council has agreed to join Fort Worth in sponsoring construction of an airport midway between the two cities near Arlington, on a 1000-acre site to be purchased by commercial airlines and to be developed by the federal government. The airport will serve Dallas and Fort Worth as well as Arlington which has already obtained $490,000 in a federal grant to develop a midway airport. It will be used for military purposes during the national defense emergency. Officials predict that federal grants totaling $2,000,000 or more would be allocated for the airport later on.

* * *

One of the best airports in its section of the country is nearing completion at Peru, Neb., and plans are being made for an impressive dedicatory program in the near future.

Perfect underground drainage is supplied by the sandy foundation on the 90-acre tract, and the topsoil has been made firm and smooth by four tractors pulling drags. The new 60 × 90-ft hangar, almost finished, has space for nine planes. An office, classroom and workshop have been included. M. L. Powell, flight instructor, will supervise classes in mechanics.

* * *

Four more new airports are under construction in Nebraska as a part of the State Aeronautics Commission's 10-year program. The fields are at O'Neill, Neligh, Clay Center and Imperial, and when completed will bring the total in the state to 55. A total of 110 airports for the state is contemplated.

Improvements

The $585,317 expansion project at the Omaha, Neb., municipal airport was completed in October. The WPA project begun last winter, adds a new E-W runway, extension of the northeast runway and drainage and other improvements on more than 150 acres added at the north end of the field. This brings the operating field area above 400 acres.

* * *

The airport at Ada, Oklahoma, is being improved with the building of two runways. Each will be 4275 ft long and 150 ft wide.

* * *

Announcement has been made by city officials of Pueblo, Col., that improvements amounting to $450,000 will be made to the local airport with the assistance of the CAA and WPA. A $500,000 defense project now being completed at the airport, provides two wide runways.

* * *

A $30,000 expansion program is under way at the Curtiss-Wright airport by Milwaukee Airways, Inc., to include the purchase of four additional training planes to augment its present fleet of 21 ships and the installation of an airplane engine overhaul shop, according to Merle C. Zuehlke, secretary-treasurer of the company.

May Revise Love Field Fees

Acting City Manager V. R. Smitham of Dallas is considering a revision of fees charged for various services at Love Field, to make the airport self-supporting.

Announcement was made that during the fiscal year ending Sept. 30, 1941, Love Field revenue was $50,207. Expenses amounted to $51,946, exclusive of cost of servicing bonds that were issued for improvements on the airport.

Takes Over Marietta Airport

Georgia Air Service, an Atlanta concern which also operates an Air Corps Training Detachment at Bennettsville, S. C., has leased commercial operations at the new Atlanta-Marietta airport.

Construction of the new airport, located 14 miles north of Atlanta, should be completed on or about January 1. 563 acres have been leveled off and provided with three runways 500 ft wide and 4500 ft long (to be extended to 6000 ft). Administration buildings and service equipment are being developed.

Establishment of repair, overhaul and storage service for owners of private planes, and for transient flyers, completes the plan for an airport which can successfully relieve Atlanta's old municipal airport of heavy traffic congestion.

Officials of the company are Cody Laird and Ralph Lockwood.

Construction work under way at the 563-acre Atlanta-Marietta airport

Washington National Airport Gets Crash Boat

An important addition was made recently to the safety equipment of the Washington National Airport when a fire and crash boat was delivered by the Owens Yacht Co., Dundalk, Baltimore.

This boat has the standard Owens 30′ 6″ mahogany hull. Its fire-fighting equipment consists of two pumps attached directly to the Chrysler *Crown* motive power engines. Each of the pumps is capable of pumping 250 gallons of water per minute, and each can throw two streams of water simultaneously. Additional fire-fighting equipment consists of a Foam-Air tank containing enough chemical to make 1000 gallons of liquid. Four large portable fire extinguishers are carried as well as two special carbon-dioxide extinguishers.

The forward cabin is provided with four litters, and a dispensary is part of the equipment. The boat is powered with two 110 hp Chrysler *Crown* motors, and has a speed of 25 mph.

Record Placement

Seventy per cent of the workers trained in the airport ground classes sponsored by the CAA, WPA, NACA, and Office of Education have been able to get jobs immediately upon the completion of their training, according to Brig.-Gen. Donald H. Connolly, Civil Aeronautics Administrator.

Ground service training is given at operating airports under the direction of an experienced instructor. The first classes were started less than six months ago when it became obvious that the industry was threatened with an extreme shortage of ground personnel.

The course is designed to give 90 days of intensive training to qualified applicants taken from WPA lists.

C & S Buildings Dedicated

The City of Memphis on Oct. 5 formally dedicated Chicago & Southern Air Lines' general office building and general overhaul base at the Municipal Airport there.

Chicago & Southern Air Lines moved from St. Louis during the latter part of April and now occupies the new facilities on the Memphis airport. Construction work started Sept., 1940, and was completed Sept. 25, 1941. About $250,000 was spent on its buildings which are a part of the $1,239,454 Memphis airport expansion program.

OCT. 1-NOV. 7
Aeronautical Exhibition, Winged America. Maryland Academy of Sciences, Baltimore. W. O. Collier, Society of Aeronautical Research, Baltimore.

NOV. 11
Formal dedication. Braniff Airways operations and maintenance base. Love Field, Dallas.

DEC. 1
Convention Air Line Mechanics Association. Del Prado Hotel, Chicago.

DEC. 1-2
Annual convention and business session. National Aviation Training Association. Kansas City, Mo.

DEC. 17
Institute of the Aeronautical Sciences. Wright Brothers lecture and dinner. Columbia University, New York, N. Y.

JAN. 9-11, 1942
All-American Air Maneuvers and aeronautical exhibit. Sponsored by Greater Miami Airport Association. Miami International Airport.

JAN. 10
Formal dedication, North American Aviation bomber assembly plant. Kansas City, Kansas.

JAN. 27
Honors Night Dinner. Institute of the Aeronautical Sciences. Waldorf-Astoria Hotel, New York, N. Y.

JAN. 28-30
Tenth Annual Meeting. Institute of the Aeronautical Sciences. Pupin Physics Laboratory, Columbia University, New York, N. Y.

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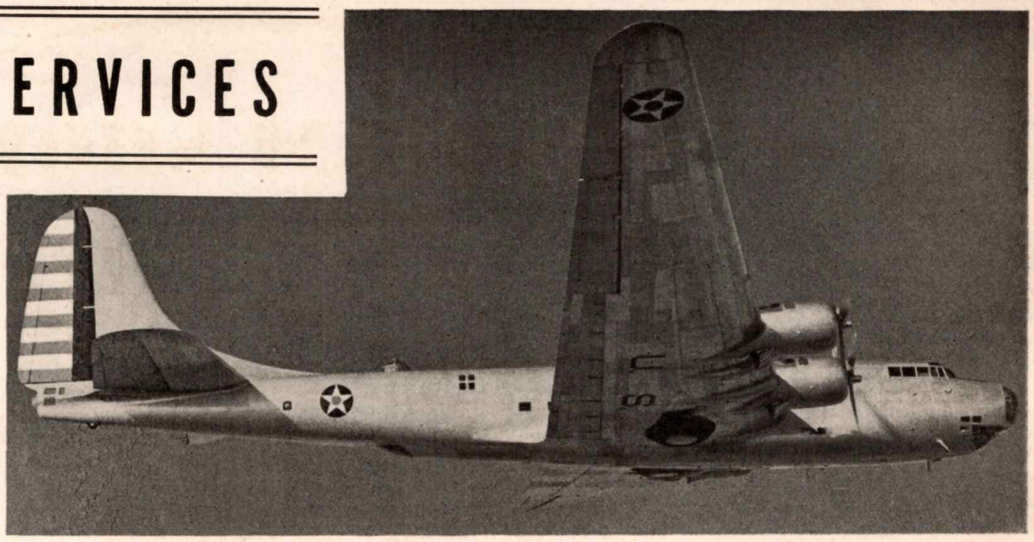
THE AIR SERVICES



The Douglas B-19 taken in flight during one of the test runs near the end of its exhaustive testing program

Army Gets New Transport

The Curtiss transport designed for the airlines, but converted into a military cargo transport, has been accepted by the U. S. Army Air Forces after exhaustive flight tests and a large number of similar design will be produced by the Airplane Division of Curtiss-Wright Corp. in its Buffalo and St. Louis plants, Burdette S. Wright, vice-president and general manager of that division, announced last month.

Designated the Curtiss C-55 cargo-transport type by the Air Force, the prototype was originally designed and produced at the St. Louis plant of Curtiss-Wright Corp. to transport 36 passengers, a crew of five and 5000 lb of baggage and express at a speed of over 3½ miles per minute at high altitudes. It has a span of 108 ft, is 76.6 ft long, weighs 40,000 lb fully loaded. Power is supplied by 1700 hp Wright *Cyclone* engines. The type to be produced in the future will be designated the Curtiss C-46.

The Curtiss Transport was completed and flown for the first time last year. Combining huge carrying capacity and long range, it was demonstrated to the Air Force and found to be suited for cargo and troop transport operation. It was then converted into an Army Transport; the food galley became an ultra-modern navigation compartment; additional fuel tanks were installed to increase its already great operating range; numerous other changes were made.

Army Field in Texas Nears Completion

Construction work on the Advanced Twin-Engine and Bombardier Training Center at Sloan Field, Midland, Texas, is now more than half complete and a few days ahead of schedule. Foundations have been finished for 180 of the 205 buildings and work is being rushed on them by carpenters. Asbestos siding has been placed on 41 of the buildings, and 87 have asbestos roofs. All areas of the field are being worked on intensely and it is expected to be ready for the Army next month.

Army Gets Piper Trainers

As a result of extensive summer testing in actual maneuvers, an unannounced number of Piper airplanes have been delivered to the U. S. Army Air Corps for service tests at Wright Field, Dayton, Ohio. The ships, designated by the Army as the YO-59, are almost identical with the familiar Piper *Cub Trainer*.

Powered with a Continental 65 hp engine and equipped with two-way radio, the planes are to be used for liaison work, message carrying, observation, and transportation of officers. Because of the inability to take off and land on unprepared fields, highways, roads, and small pastures, the planes have been found highly effective and efficient in speeding up communications.

Animated Ground Instruction

A new course in airplane operations highlights the newest Ground School Program in the Air Corps inaugurated at Randolph Field last month.

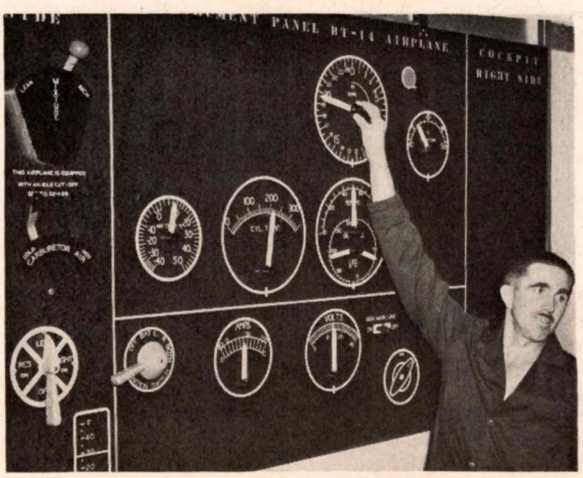
Airplane and engine instruction for aviation cadets at Randolph now focus more sharply on the man in the cockpit—even when he's on the ground, and to stress the pilot's angle, classrooms in Hangar V virtually have become gigantic cockpits.

Instrument boards charted to scale and huge as small billboards are the answer. They boast every dial and control a pilot sees in the cockpits of BT-9 or BT-14 basic trainers. Instructors can move all indicators by hand, show students the combinations that spell safety or danger in the air. Other big wall-panels show working parts of planes—oil lines, fuel tanks, ignition systems.

Randolph's instructors believe they've found a better way to train better pilots. They've also saved man-power, because one instructor can teach 20 Cadets, faster and more efficiently.

B-19 Nears End of Testing

With more than half of its long and exhaustive acceptance testing program now successfully completed, the Douglas B-19 entered a more intensive stage of activities last month.



One of the wall panels used for instructing cadets at Randolph

Flight tests to date have resulted in many improvements to engine cowling, carburetion and other important functions providing increased power output of the four 2000 hp Cyclone engines.

This new efficiency is expected to produce for the world's largest bomber a top speed performance considerably in excess of the Air Corps specifications.

B-24 Sets Record

One of the first four-motored Consolidated B-24 bombers built for the U. S. Army Air Corps accounted for several new flight records early last month, according to Army reports.

Averaging 237 mph, Lieut. Col. Caleb V. Haynes, piloted the plane on a 26,000-mile flight which carried him over North Africa and the Near East war zones.

On the return trip, across the South Atlantic for 3400 miles from Takoradi on the British Gold Coast, West Africa, to Belem, Brazil, Col. Haynes was in the air 13 hours 45 minutes.

The westward flight, in the direction of the sun's path, was said by Army officials to be the greatest distance ever flown between sunrise and sundown.

Col. Haynes was on assignment to transport Major General George H. Brett, Chief of the Army Air Corps, to the Near East war zone to confer with British aviation authorities.

Navy Gives Planes Names

The old method of designating aircraft by a series of numbers has been abandoned by the Navy's Bureau of Aeronautics, and henceforth Navy combat aircraft will be given descriptive names in

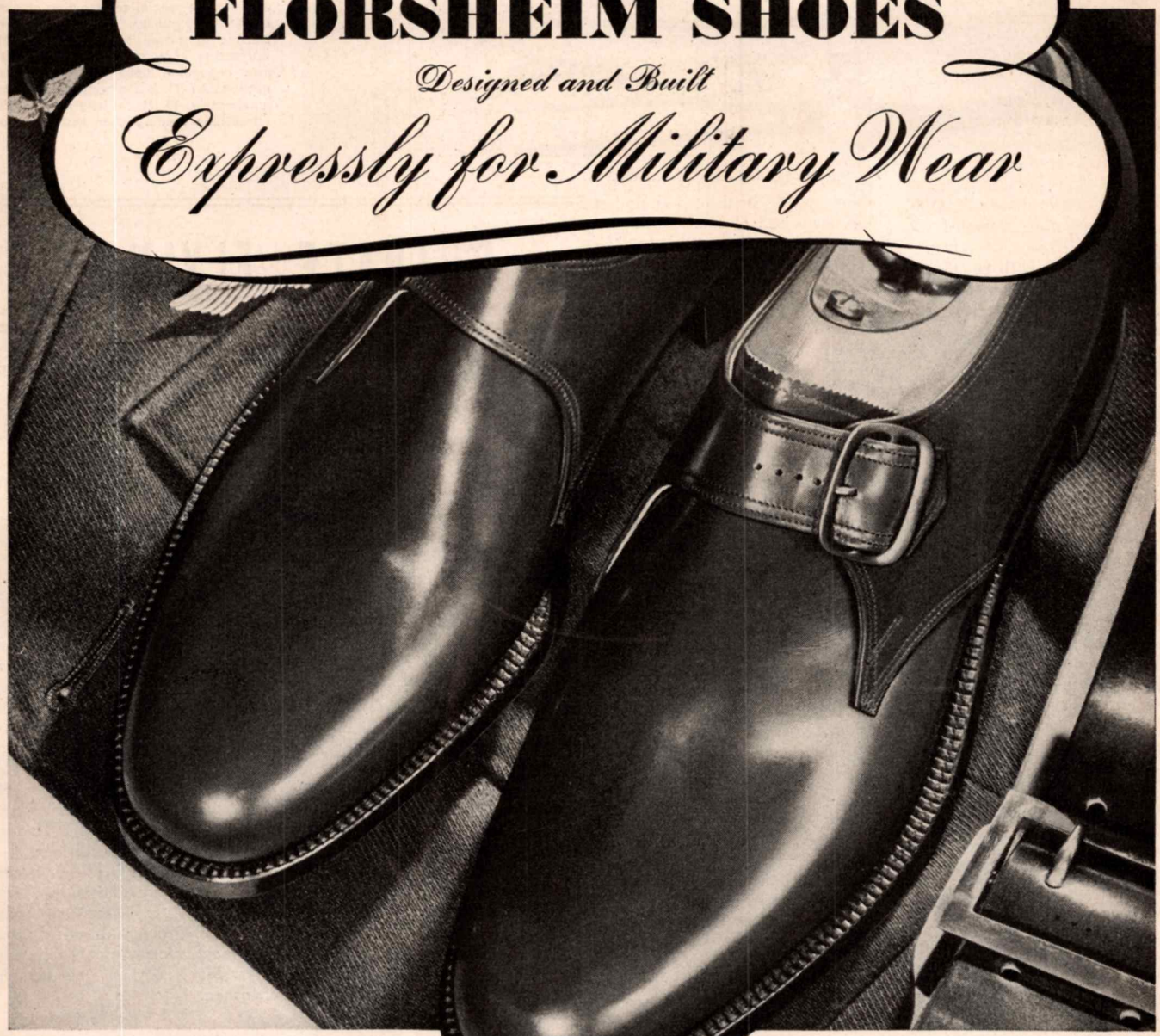
(Continued on following page)

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

FLORSHEIM SHOES

Designed and Built

Expressly for Military Wear



The MILITARY, $10.50

The FLORSHEIM Shoe

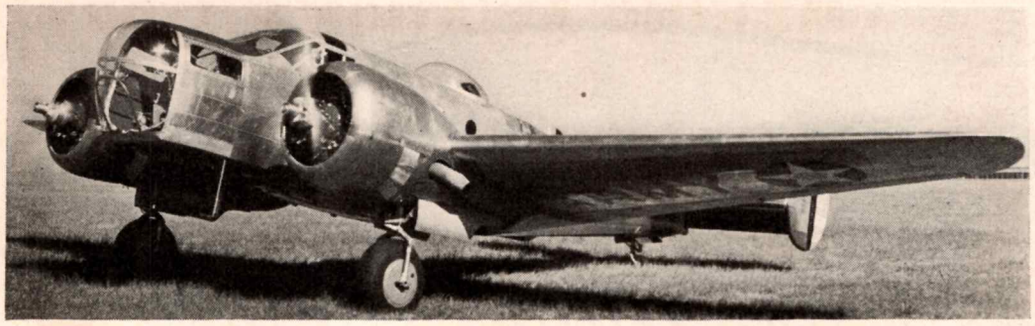
We made them at the request of thousands of reserve officers, who were accustomed to the superior fit, comfort, and wear of Florsheim civilian styles. When called up for active duty, they helped us design a special last to meet all Military specifications: straight inside line; extended rubber heel; arch-cradling shank, and seamless, chafeless quarter-linings. This last is now reserved exclusively for Florsheim Military Styles . . . the shoes worn today by more Army, Navy, Marine, Air Corps, and Coast Guard officers than any other Quality line!

$9.50 and $10 *Most Styles*

WRITE FOR THE ADDRESS OF YOUR NEAREST FLORSHEIM DEALER OR STORE

THE FLORSHEIM SHOE COMPANY • CHICAGO • *Manufacturers of Fine Shoes for Men and Women*

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



Delivery of the first Beech AT-11, a twin-engine (P & W 450 hp) advanced training airplane (left), was announced last month by the War Department. This low-wing, all-metal monoplane will be used for the specialized training of bombardiers and gunners. It is equipped with flexible guns and bomb racks for the instruction of a crew of three or four men depending upon the instructional mission. AT-11 has a wing span of approximately 47 ft, a length of 35 ft, retractable landing gear and twin tail

(Continued from preceding page)

keeping with their intended missions.

Dive bombers will be named: *Helldiver* for the Curtiss SB2-C; *Dauntless* for the Douglas SBD; *Vindicator* for the Vought-Sikorsky SB2U; and *Buccaneer* for the Brewster SB2A.

Other original designations and their new names are: FIGHTERS:—Brewster F2A, *Buffalo*; Grumman F4F *Wildcat*; Vought-Sikorsky F4U, *Corsair*.

OBSERVATION SCOUTS: — Curtiss SO3C, *Seagull*; Navy PS2N and the Vought-Sikorsky OS2U, both to be known as *Kingfisher*.

PATROL BOMBERS:—Boeing PBB, *Sea Ranger*; Martin PBM, *Mariner*; Consolidated PBY, *Catalina*; Consolidated PB2Y, *Coronado*.

TORPEDO BOMBERS: — Douglas TBD, *Devastator*; Grumman TBF, *Avenger*.

More RAF Cadets Training

Forty-eight percent of all aviation cadets now being trained in the Southeast Air Corps Training Center are British.

The announcement came with the arrival last month of 750 new British cadets at the Air Corps Replacement Center at Montgomery, Ala. As the RAF flag was run up over one section of barracks, it was learned that the number of incoming Britishers was only slightly overshadowed by the 822 Americans already ensconced there for pre-flight training.

In elementary schools in the Southeast there are 1040 British trainees to the United States' 669. An even more overwhelming predominance is seen in Basic schools where the British outnumber Americans 622 to 190.

American cadets are still flying all advanced training ships, however, since the British trainees have not yet reached the advanced stage of the flying course. There are 651 American cadets in Advanced flying schools, 238 navigators and bombardiers at specialized training units in the Southeast Training Center.

Large-Scale Transfer

Four hundred and seventy-six Randolph Field soldiers were transferred recently to squadrons scheduled for assignment to the new training school fields at Waco, Texas, and Enid, Okla.

Of the total, 237 will go to Enid and 239 to Waco, with 14 squadrons actually involved in the transfer. In addition, 13 officers were assigned to duty with the new units.

The recently activated U. S. Army Air Forces outfits being sent to Enid include the 472nd, 473rd, 474th, and 475th School Squadrons and the 60th Air Base Group (Sp) which includes three separate units. The 468th, 469th, 470th, and 471st School Squadrons and the 59th Air Base Group (Sp), including three more separate units, will go to Waco.

Strength of the school squadrons, to whose rosters more men will be added within a few weeks, is now from 35 to 40 men, including from six to 12 non-commissioned officers. The Air Base groups number about 75 men each. Each squadron, however, will be built up to 200 men after reporting to the new stations.

PRIVATE FLYING

Civilian Flying Corps Gets Plane from Reynolds

Formation of Civilian Flying Corps units in every state was forecast last month at Richmond, Va., by J. Louis Reynolds, vice-president of Reynolds Metal Co., in connection with his company's donation of a training plane to the Richmond-Hopewell-Petersburg regional flying corps unit, which has been approved by Governor James H. Price and Adjutant-General S. Gardner Waller as part of the Virginia Protective Force.

Reynolds said his company would give a plane to this unit and announced the start of a movement to persuade industrialists and other business men in cities and towns throughout the state to give other planes to flying corps units to be formed in seven other defense areas in Virginia. The plan also calls for the donors to furnish hangar space and service for the planes given to the defense corps.

When the plan is thoroughly in operation in Virginia, Reynolds said it would be extended to other states.

Club Activities

The Ballinger Flying Club, Ballinger, Tex., has been granted a charter by the State of Texas. Incorporators are John J. Pichinson, Harry J. Rogers and A. W. Tarrant.

* * *

A unit of the Women's National Aeronautical Association, only three of which have been chartered in Texas, was formed last month in Stamford. Other units are in Houston, Dallas and Fort Worth.

* * *

George E. Haddaway of Dallas was re-elected chairman of the Texas Chapter of Ninety-Nines, at the chapter's first annual convention in Corsicana. Dallas was chosen as the 1941 convention site for the Texas Private Fliers Association, which met in conjunction with the Ninety-Nines. The convention will be held Nov. 22 and 23. Chairman C. A. Miles, Jr., and Secretary George E. Haddaway, conducted the meetings.

Officers chosen by the Texas Ninety-Nines, in addition to Mrs. Haddaway, are: Miss Mary Hunter, vice-chairman; Miss Josephine Broadbent, secretary-treasurer, and Miss Mary Myers, membership chairman.

* * *

Lt. Gov. W. E. Johnson of Nebraska was elected president of the Nebraska Aeronautical Association at the recent annual meeting in Lincoln. He succeeds E. J. Critchfield. Alva White was elected vice-president succeeding Sam Stull, and J. R. Gobble, secretary of the Beatrice Chamber of Commerce, was re-elected secretary-treasurer.

* * *

An Omaha chapter of the NAA has been reorganized after a 10-year lapse. Al Wolf was named president; Gould Dietz, vice-president; Bernard Wickham, director, and A. C. Armbruster, secretary-treasurer.

* * *

Aircraft Club, Inc., Scottsbluff, Neb., non-profit, has been incorporated to own and maintain air-

(Continued on following page)

Piper YO-59, powered with a Continental 65, delivered recently to the Army Air Forces

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

MAKING AVIATION HISTORY

There's a quick beat in all our hearts for the members of the U. S. Army Air Corps. Their wings speed them in their watch over American skies in miracle time—the nation's modern Minute Men. Among the Air Corps' most advanced aircraft is our Bell Airacobra—the world's only single engine fighter carrying an armor-piercing cannon. Bell Aircraft has grown to 10,000 loyal employees in meeting the urgent need for Airacobras. Masterfully trained in the important tasks of volume aircraft production, each Bell worker now joins in a faithful pledge that the U. S. Army Air Corps shall be proud of the job that's being done in producing Bell Airacobras.

Bell Aircraft

Producers of
THE BELL AIRACOBRA
"Cannon on Wings"

BELL

© Bell Aircraft Corporation, Buffalo and Niagara Falls, N. Y.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

Mrs. Evelyn Burleson and the Taylorcraft in which she set a new record by flying non-stop between Vancouver, B. C., and Tiajuana, Mexico

(Continued from preceding page) planes. Incorporators are Fred Chearis, Wilford Lane, Bill Ostenberg, Norris Rock, Alvin Deavers, Jack Mack, Jr., Miriam Ostenberg, Jack Fine, Lon Herron and Louis Ledbetter.

New Association

Articles of incorporation were filed last month with the Secretary of State, covering an association in Minnesota set up to represent interest of licensed pilots.

Confining its operations to the state, Minnesota Airmen, Inc., the new organization will seek memberships from all licensed pilots in Minnesota "and other persons interested in aviation from the pilot's viewpoint."

A specific program of work awaits action by the Board of Directors, which has just been named. Articles of incorporation state purposes of the new organization to be: to afford a means of cooperation between its members and governmental agencies on aviation matters; to foster the development of aviation in all its aspects; to foster the mutual improvement of its members; to foster the study of the arts and sciences connected with aviation; and to gather, compile and publish economic and industrial statistics and other information.

Eligible as members of the association are persons holding any type of pilot's license, and such other persons interested in aviation as may be approved by the Board of Directors. Provision is made for associate membership of persons and firms having an interest in the development of aviation. Likewise room is left for conferring of honorary memberships in certain cases.

Officers of the Association, who also serve as directors, are: L. Millar Wittig, president; G. B. Van Dusen, vice president; Marcellus King, secretary; and Art Hoffman, treasurer. Also serving on the Board of Directors are Gil Hartley, Mark Hurd, A. C. McInnis, Thomas North, and B. G. Vandre.

Boeing Students Form Glider Organization

Fifteen students of the Boeing School of Aeronautics, Oakland, Calif., have formed a group to build and operate a sailplane under the direction of Dr. Maurice A. Garbell, member of the Soaring Society of America and holder of a soaring pilot license.

Incorporators of the newly organized Minnesota Airmen, Inc. (l-r) G. B. Van Dusen, Art Hoffman, and Marcellus King

Although the work will be an extra-curricular activity for the students, they will have the use of the school's construction and repair shop while building their glider. Organizing members are Dr. Garbell, adviser; Weston Arment, chairman; Charles B. Lapp, secretary-treasurer; Seymour Bernstein, production manager; John P. Archibald, Peter Bowers, Stuart Campbell, Leslie Dunton, Charles Glyson, Will Hall, Hollister Hogue, John R. Jones, Warren G. Lardie, Russell B. Light and George Wilson.

Miami Plans Biggest Event

Getting off to their earliest start, plans for the annual Miami All-American Air Maneuvers were completed last month with indications pointing to 1942 as a banner year in Miami air race history.

Directors of the annual Miami Aerolympics, forecast not only the biggest aerial show but anticipate a large gathering of America's aviation fraternity in Miami during the three days of the meet scheduled for January 9, 10 and 11.

The Air Maneuvers will offer a program including stunt aerialists, precision flying teams, air comedy acts, parachutists and a racing program for stock planes. The stunt and racing program is being compiled now by Carl Fromhagen, contest director.

Aeronautical Charts

New editions of aeronautical charts were announced last month by the Department of Commerce, U. S. Coast and Geodetic Survey. Pilots are warned that these new editions of charts cancel previous editions which are obsolete. Regional charts, a series of 17 scaled at 1:1,000,000, sell for 40c; direction finding charts, a series of 6 scaled at 1:1,200,000, sell for 40c and sectional charts, a series of 87 scaled at 1:500,000, sell for 25c. On orders grossing $10 or more, including assortments, there is a 33⅓% discount. Copies of these charts may be obtained from the U. S. Coast and Geodetic Survey, Washington, D. C., and from recognized dealers at major cities and airports.

Sectional Charts

BELLINGHAM:—Lat 48°-50° N., long 120°-126° W., an area of about 45,000 sq mi. Canadian radio ranges realigned and civil airways added in Canada.

CLEVELAND:—Lat 40°-42° N., long 78°84° W., an area of about 51,000 sq mi. Radio ranges realigned at Columbus and Cleveland and civil airways revised.

DOUGLAS:—Lat 30°-32° N., long 108°-114° W., an area of about 57,000 sq mi. Accumulation of changes since last edition.

DULUTH:—Lat 46°-48° N., long 90°-96° W., an area of about 47,000 sq mi. Accumulation of changes since last edition.

GLACIER PARK:—Lat 48°-50° N., long 108°-114° W., an area of about 45,000 sq mi. Civil airways added and accumulation of changes since last edition.

KOOTENAI:—Lat 48°-50° N., long 114°-120° W., an area of about 45,000 sq mi. Addition of Kibberly radio range. Civil airways added in Canada and accumulation of other changes since the last edition.

LA GRANDE:—Lat 44°-46° N., long 114°-120° W., an area of about 47,000 sq mi. Controlled civil airways revised and accumulation of changes since last edition.

LAKE SUPERIOR:—Lat 46°-48° N., long 84°-90° W., an area of about 47,000 sq mi. Accumulation of changes since last edition.

LINCOLN:—Lat 40°-42° N., long 96°-102° W., an area of about 51,000 sq mi. Accumulation of changes since last edition.

SALINA:—Lat 38°-40° N., long 96°-102° W., an area of about 52,000 sq mi. Addition of radio range at Hutchinson and accumulation of changes.

TULSA:—Lat 36°-38° N., long 90°-96° W., an area of about 53,-000 sq mi. Chanute radio range realigned and accumulation of changes since last edition.

TWIN CITIES:—Lat 44°-46° N., long 90°-96° W., an area of about 47,000 sq mi. Radio ranges realigned La Crosse and Alexandria.

Evelyn Burleson Sets Record in Taylorcraft

Averaging 103 mph for 1700 miles, Mrs. Evelyn Burleson on Oct. 1 flew from Vancouver, B. C., to Tiajuana, Mex., to set a new non-stop, non-refueling flight record covering three nations. Requiring 16.5 hrs for the trip, Mrs. Burleson piloted a 1940 deluxe Taylorcraft powered by a 65 hp Lycoming engine.

Mrs. Burleson is a flight instructor and co-owner with her husband of Burleson Flyers, Inc., of Albany, Oregon. She carried messages from the Governor-General of British Columbia to Mexican officials, and she had the airplane painted and decorated to harmonize with hemisphere defense programs.

The ship was equipped with extra fuel tanks to carry a total of 82 gal. of fuel. The extra tanks, gas and oil, parachute, wobble-pump and other equipment in addition to the pilot, brought the total weight of the Taylorcraft to more than 1450 lbs, 300 lbs over weight. Mrs. Burleson reported she had at least 20 gal. of gas left on arrival in Mexico.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

THIS—

Spartan School Photograph

is getting it on the line!

At Spartan School in Tulsa, and in scores of other schools, the broad line of America's defense begins. More than two hundred husky Fairchild Trainers in Spartan schools alone start the instruction of Air Corps cadets, flight instructors, and civilian students.

Throughout this country, in Canada, and in South America, modern fighting pilots learn faster by using the modern low-wing, full cantilever Fairchild Trainer. And to meet their needs Fairchild is getting additional hundreds of these Trainers on the line in record time!

FAIRCHILD AIRCRAFT

Division of Fairchild Engine & Airplane Corporation
Hagerstown, Maryland . . . Cable Address "Faircraft"

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

S. S. WHITE FLEXIBLE SHAFTS are Universally Used in the Nation's Aircraft!

AIRCRAFT USES OF S. S. WHITE FLEXIBLE SHAFTS . . .

POWER DRIVE

Engine Tachometers
Fuel Pumps
Controllable Pitch Propeller Governors
Ammunition Rounds Counters
Windshield Wipers
Cowl Flap Mechanisms

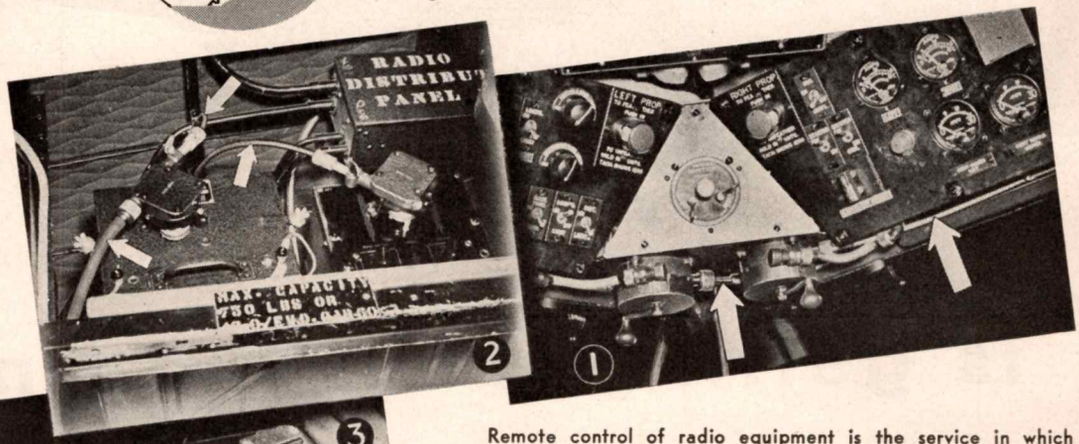
REMOTE CONTROL

Radio Receivers
Beacon Receivers
Compass Loops
Antenna Loops
Antenna Reels
Heating Registers
Tab Controls
Turn Bank Indicators

In both commercial and military aircraft almost without exception, S. S. WHITE Flexible Shafts will be found performing one or more of the important functions listed at the left. The ideal way in which S. S. WHITE Shafts serve these purposes and their proven quality and dependability account for this universal use. This is one of a series presenting applications in planes of the leading airlines.

EASTERN Air Lines

In EASTERN Air Lines Great Silver Fleet!



Remote control of radio equipment is the service in which S. S. White Flexible Shafts are employed on ships of The Great Silver Fleet. The shafts used are of the type specially developed by S. S. White for remote control.

1. Section of the control panels in the cockpit of an EAL SilverLiner. Arrows point to the S. S. White Flexible Shafts connected to the two "coffee-grinder" type controls, one of which operates a Western Electric 14A Beacon Receiver—the other operates a reserve Western Electric 17A Beacon Receiver.

2. Beacon Receivers in a compartment aft of the cockpit. Upper arrow points to the flexible shaft from the control unit to the geared connection on the 14A Receiver, from which same connection a second shaft (lower left) goes to the Loop Coupler, providing simultaneous operation of Receiver and Coupler. Arrow at right indicates the control shaft to the 17A Receiver.

3. Shows flexible shaft from the 14A Receiver connected to the Loop Coupler in the lower part of the compartment.

DETAILS about S. S. WHITE Flexible Shafts for Power Drives are given in Bulletin 1238—for Remote Control in Bulletin 38. Copies mailed on request. Engineering cooperation always available.

S. S. WHITE

The S. S. White Dental Mfg. Co.

INDUSTRIAL DIVISION

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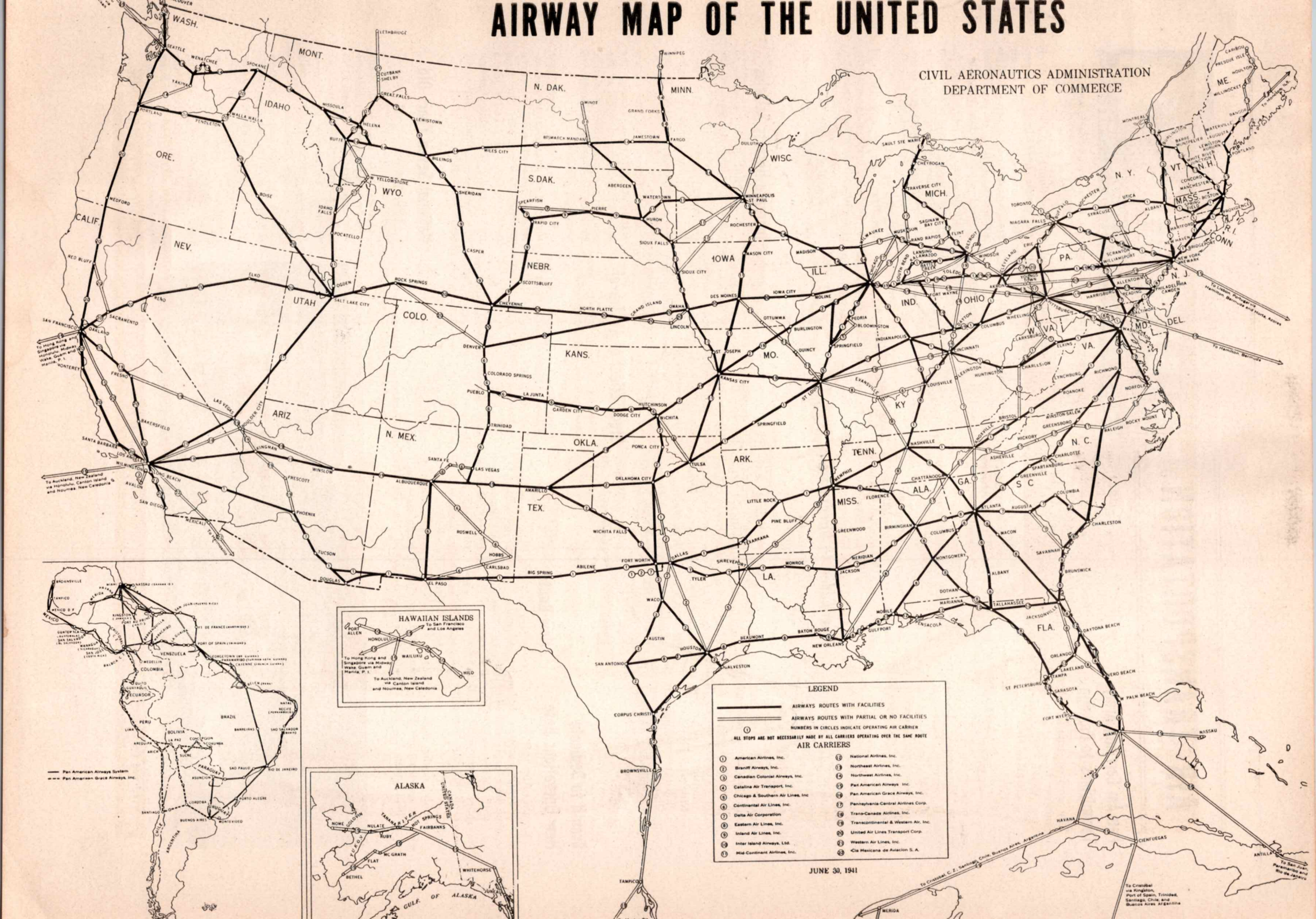
PACIFIC COAST REPRESENTATIVE • PACIFIC SCIENTIFIC COMPANY • LOS ANGELES, SAN FRANCISCO

PIONEER AND LEADING MAKER OF FLEXIBLE SHAFTS FOR POWER DRIVES, REMOTE CONTROL AND COUPLING

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

AIRWAY MAP OF THE UNITED STATES

CIVIL AERONAUTICS ADMINISTRATION
DEPARTMENT OF COMMERCE



HAWAIIAN ISLANDS
To San Francisco and Los Angeles
PORT ALLEN
HONOLULU
WAILUKU
HILO
To Hong Kong and Singapore via Midway Wake, Guam and Manila, P. I.
To Auckland, New Zealand via Canton Island and Noumea, New Caledonia

LEGEND

AIRWAYS ROUTES WITH FACILITIES

AIRWAYS ROUTES WITH PARTIAL OR NO FACILITIES

(1) NUMBERS IN CIRCLES INDICATE OPERATING AIR CARRIER

ALL STOPS ARE NOT NECESSARILY MADE BY ALL CARRIERS OPERATING OVER THE SAME ROUTE

AIR CARRIERS

(1) American Airlines, Inc.	(12) National Airlines, Inc.
(2) Braniff Airways, Inc.	(13) Northeast Airlines, Inc.
(3) Canadian Colonial Airlines, Inc.	(14) Northwest Airlines, Inc.
(4) Catalina Air Transport, Inc.	(15) Pan American Airways Inc.
(5) Chicago & Southern Air Lines, Inc	(16) Pan American Grace Airways, Inc.
(6) Continental Air Lines, Inc.	(17) Pennsylvania-Central Airlines Corp.
(7) Delta Air Corporation	(18) Trans-Canada Airlines, Inc.
(8) Eastern Air Lines, Inc.	(19) Transcontinental & Western Air, Inc.
(9) Inland Air Lines, Inc.	(20) United Air Lines Transport Corp.
(10) Inter Island Airways, Ltd.	(21) Western Air Lines, Inc.
(11) Mid-Continent Airlines, Inc.	(22) Cia Mexicana de Aviacion S. A.

JUNE 30, 1941

AIR TRANSPORTATION

Three-place Bellanca Cruisair used for feeder work by State Airlines

Pan Am Carrying Army Technicians to Panama

The greatest transfer of Army technicians by air ever attempted in the Western Hemisphere has been undertaken for the U. S. Army by Pan American Airways from its inter-American division terminal at Brownsville, Tex. By agreement between the airlines and the Engineering Office of the War Department, more than 700 men urgently needed on defense work at the Canal Zone are being flown from the United States to Panama within a period of 90 days.

The movement is being carried out with a minimum of interference with regular inter-American air traffic by the addition of a special section to Pan American's daily service between Brownsville and the Canal Zone. The first contingent of 127 Army men involved in this transfer already has been accommodated.

To carry out this movement, the daily shuttle which connects Brownsville with Mexico City, will be extended to overnight at the Capital of Mexico and starting with the following morning will proceed directly to the Panama Canal Zone.

Braniff to Dedicate New Operations Base

Braniff Airways' new quarter-million dollar operations and maintenance base at Love Field, Dallas, will be formally dedicated November 11, as part of the Dallas junior chamber of commerce air show.

Ground-breaking ceremonies starting construction of the base were held June 12, 1941. Steel construction was completed on August 18. Construction is of concrete base, steel framing and prefabricated steel covering.

Revenue bonds were issued by the city of Dallas to cover part of the construction cost, and Braniff Airways advanced the balance. The bonds are to be amortized in ten years by Braniff Airways, which holds a twenty-year lease on the property.

The base comprises a main hangar, 120 ft by 160 ft; maintenance shops 60 ft by 270 ft; a two-story, air conditioned office building containing 10,000 sq ft of space; and engine test house and other miscellaneous buildings.

Four Added to Directorate

Thomas F. Ryan III, president of Mid Continent Airlines, announced following the company's annual directors' meeting at Kansas City, that four new members were named to the Board. They were George F. Ryan, Oliver Parks, Ryal Miller and Don Murdoch. This brings the directorate up to a total of fourteen.

Those re-elected were Thomas F. Ryan III, J. W. Miller, Vernon A. Dorrell, Gen. W. W. Howes, John C. Collins, John S. Wynne, Milton McGreevy, Theodore N. Law, J. Morrell Foster, and H. Montgomery Thrall.

New Route

New and direct service between Muskegon and Chicago in Douglas DC-3 equipment was inaugurated Oct. 1 by Pennsylvania-Central Airlines, thus eliminating the necessity of routing passengers by way of Grand Rapids.

One round trip daily is scheduled, providing through service between Detroit and Chicago *via* Lansing and Grand Rapids in addition to Muskegon. The new airway will reduce the flying time between Muskegon and Chicago from 99 min to 59 min.

Fares have also been reduced. Formerly, the one-way fare was $9.95 the round-trip fare $17.91. The new fares are $7.95 one-way, $14.31 round-trip.

New Feeder Line

Aviation traffic experts have been watching the development and activities of the State Airlines of Charlotte, N. C., which at present is flying a charter line without certification between designated points on an unscheduled basis and charging regular established airline rates. Passengers are flown between these points at commercial airlines rates at the convenience of the passenger. Using the slogan, "Fly Anytime" State arranges to transport even one passenger to his destination at any time requested by the passenger.

Study Effect of Air Travel

Creation of a department of economic research to survey the aspects of aviation and study the effects of air transportation on the nation's business, industry and defense, was announced last month by Northwest Airlines, Inc.

In charge will be A. E. Floan, former district traffic manager for the airline in Seattle, who has been given the title of director of economic research. Flown, who will make his headquarters in St. Paul, will confer with public officials and business, industrial and civic leaders throughout the country on the various needs of their respective communities, so far as air transportation is concerned. This data will be used in preparation of applications for new routes.

Preliminary surveys, they revealed, have already shown that the time-saving element of air transportation is playing a major role in the development of business and opening many new trade territories. Special attention will be given the needs of communities now without air service and later, it was indicated, applications will be filed with the Civil Aeronautics board for feeder lines through these areas.

Increase Hostess Salaries

As a further inducement to registered nurses to take up the career of airline hostess, Transcontinental & Western Air, Inc., last month announced a higher salary scale for this type of employee.

Under the new scale, the hostess starts at $115 per month, the salary increasing to $135 at the end of the first year of service. Periodic increases are granted with increased seniority.

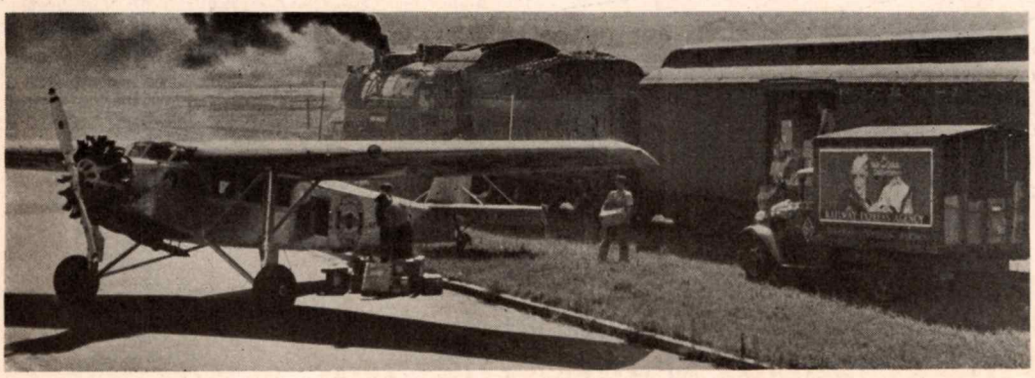
Hostess applicants must have three years' training in an accredited hospital and be between 21 and 26 years old. She must be between 5 feet 2 and 5 feet 5 inches tall and weigh between 100 and 125 pounds, depending upon her height.

National Seven Years Old

Celebrating its seventh year of service, National Airlines on Oct. 15 inaugurated a third daily round-trip flight between Jacksonville and Miami *via* Tampa. This makes a total of 4860 miles per day flown by the line which seven years ago started out with a daily service of 292 miles.

With the expansion of services and the rapid increase in traffic three 17-place Lockheed *Lodestars* were purchased in Nov. 1940. Bringing the first of these new planes from the factory in Burbank, California, G. T. Baker, president of the line, broke the transcontinental speed record by flying the 2357 miles from Bur-

(Continued on following page)



Celebration of the fifteenth anniversary of Northwest Airlines recalls the days when mail sometimes was transferred from train to plane along the train's route instead of at an airport. The plane is a Hamilton

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

ALLOYS

Timely information about metals... CATALOGUED for your convenience

Specific answers to many of your questions about the selection, fabrication and uses of Nickel alloys are available to you quickly from our files.

This fund of helpful information we have gathered, checked and condensed into convenient printed form. The graphs, charts and shop guides are especially useful to men handling new materials or performing unfamiliar operations . . . and to new employees. This literature is available on request.

You are also offered the assistance of our technical staff in solving material problems arising from a temporary lack of Nickel. These engineers are offering timely suggestions to many vital industries during the present emergency.

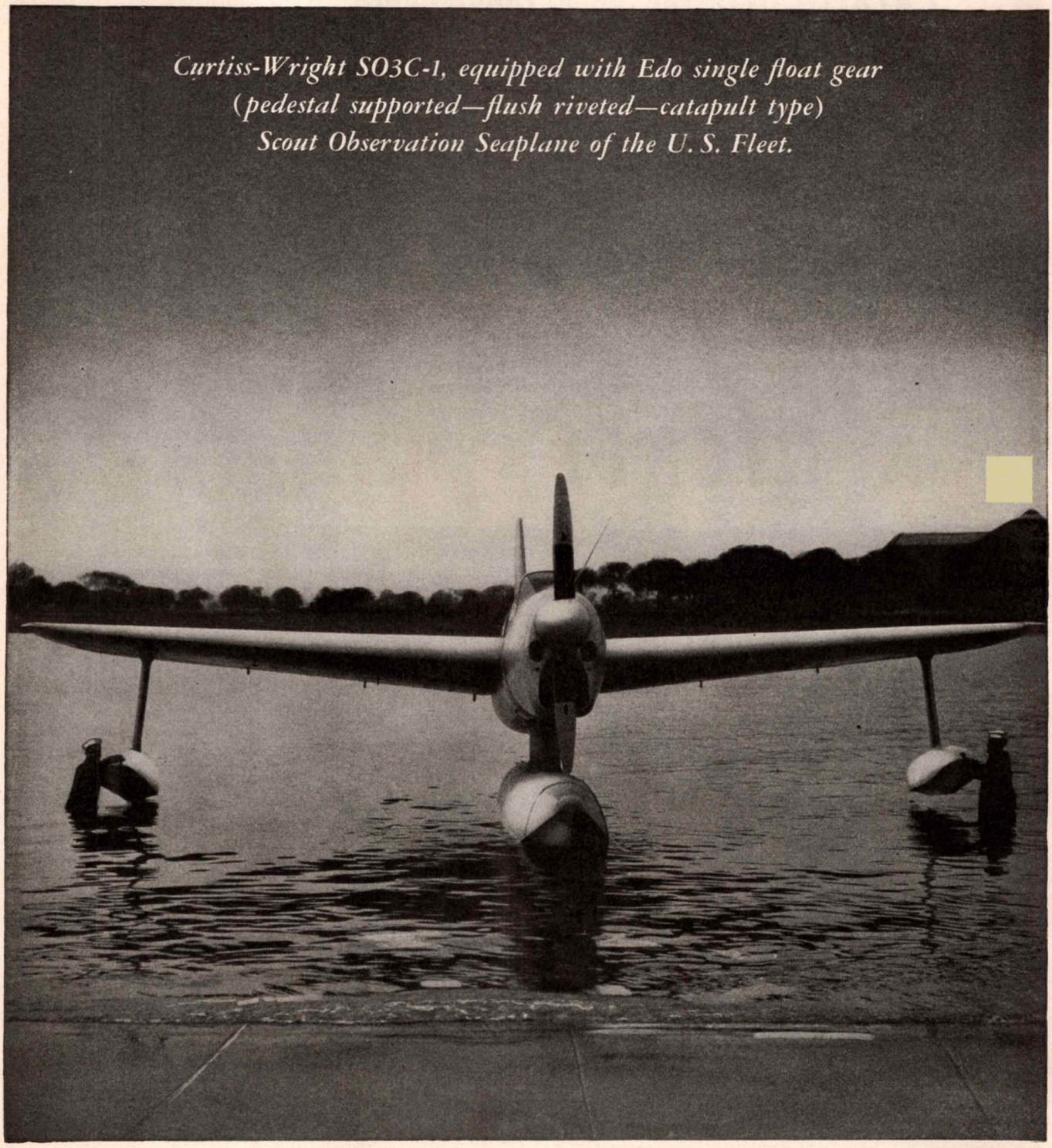
Why not drop us a card asking for list of available literature. Your request for the assistance will receive prompt attention.

NICKEL

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

EDO FLOAT GEAR

STANDARD THE WORLD OVER



Curtiss-Wright SO3C-1, equipped with Edo single float gear (pedestal supported—flush riveted—catapult type) Scout Observation Seaplane of the U. S. Fleet.

Edo manufactures single and twin float gear for military aircraft. Complete technical data and advisory engineering service available. Contractors to the U. S. Navy; U. S. Air Corps and Foreign Air Forces. Edo Aircraft Corporation, 401 Second St., College Point, N. Y., U. S. A.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

(Continued from preceding page) bank to Jacksonville in 9 hr 29 min which included time on the ground at Dallas for refueling.

United Starts Enrollment of 100 More Pilot Students

Selection of the next 100 students for its pilot-training school at Tracy, Calif. was started last month by United Air Lines by means of personal interviews with likely candidates, according to R. T. Freng, director of flight operations for United. Any person with sufficient flying qualifications and background of education and experience to correspond with that of CPT graduates will be considered, Freng declared.

Reports of United's captains show that the fifty Tracy graduates now serving as co-pilots on the company's routes "are giving an excellent account of themselves and have justified our expenditure in every way," Freng declared.

2,362,229 Passengers

Domestic air carrier operations statistics for the first eight months of the year reveal a 36.88% increase in traffic, and show that the 17 airlines carried 2,362,229 revenue passengers compared with 1,725,758 for the same period in 1940.

Largest increase during the period was recorded in the express category where poundage jumped almost 53%—from 7,463,208 lb to 11,411,738 lb. Revenue passenger mileage flown was rapidly nearing the billion mark, and with four months to go, should be well over that figure before the year closes. At the end of August, 870,736,206 passenger miles had been recorded.

For the month of August, traffic returns show 419,417 passengers carried, 1,842,858 lb of express, 12,471,701 miles.

American Airlines carried 128,408 passengers; United Air Lines 67,550; and Eastern Air Lines carried 49,439 passengers. Other traffic figures were: TWA, 48,911, PCA, 42,037; Northwest, 19,609; Braniff 15,540; Western Air, 9026; Delta, 8561; Northeast, 6762; C & S 6760; Catalina, 5820; Mid-Continent, 4103; Continental, 2721; National, 2374; and Inland, 1796.

CAB Reports

The President has approved the decision of the CAB which denied permission to Canadian Colonial Airways, Ltd., a Canadian company using the same name as the American company, to operate from Montreal to New York City. The order is effective on December 22nd. The same route is now served by the American company which owned the Canadian company until early this year. It now is dissociated. CAB found dual service is unnecessary, and that the air navigation arrangement between United States and Canada does not involve an obligation to provide competition for an American company.

* * *

Mid-Continent Airlines has applied to the CAB for an amendment to its certificates to enable it to operate eight pick-up airmail routes. AM26 would have 25 points between Kansas City and Tulsa; Kansas City-Omaha, 20; Kansas City-Des Moines, 17; St. Louis-Rochester, 31; St. Louis-Des Moines, 18; Des Moines-Sioux Falls, 12; Sioux Falls-Des Moines, 10; Des Moines-Twin Cities, 29.

* * *

Delayed heretofore for defense reasons, Continental Airlines has been advised by CAB it may now open the Wichita-Tulsa extension.

* * *

According to the fiscal report just received by the CAB from Delta Air Corp. for the year ending June 30, the controlling stock is now owned by Richard J. Reynolds, of the tobacco family. C. E. Faulk, C. E. Woolman and Biedenhorn Realty Co. own collectively 27% of the stock, while Reynolds owns about 30%.

* * *

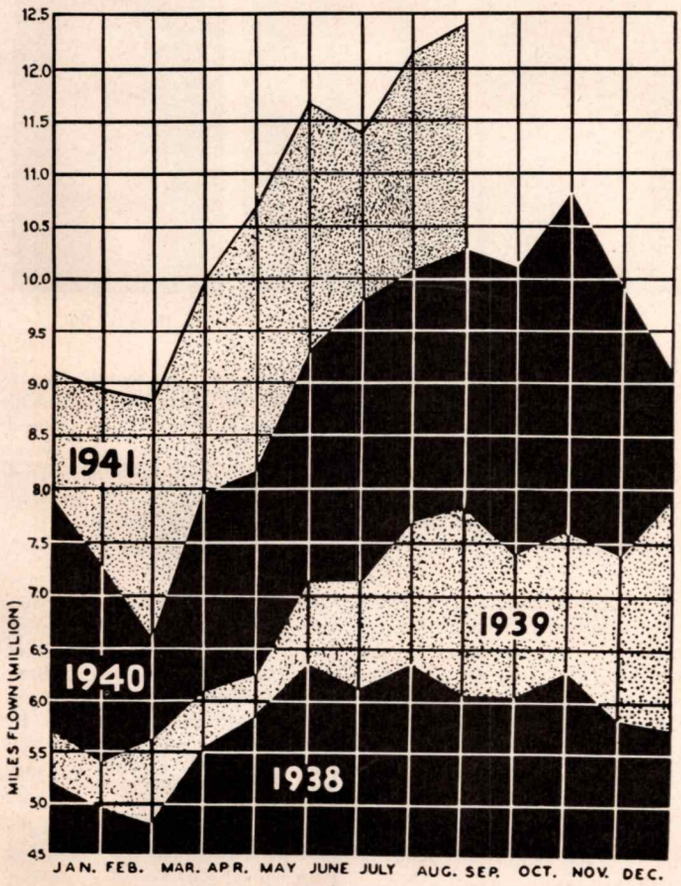
Reduction in air mail rate between San Francisco, Hong Kong, Singapore and New Zealand, on routes operated by Pan American Airways, was recommended by CAB Examiner Albert Foster. The original rate of $3.35 a mile to Manila, plus $4950 for each outbound trip from Manila to Macao or Hong Kong, is to be reduced to $2.40 a mile, even though the new route involves more mileage.

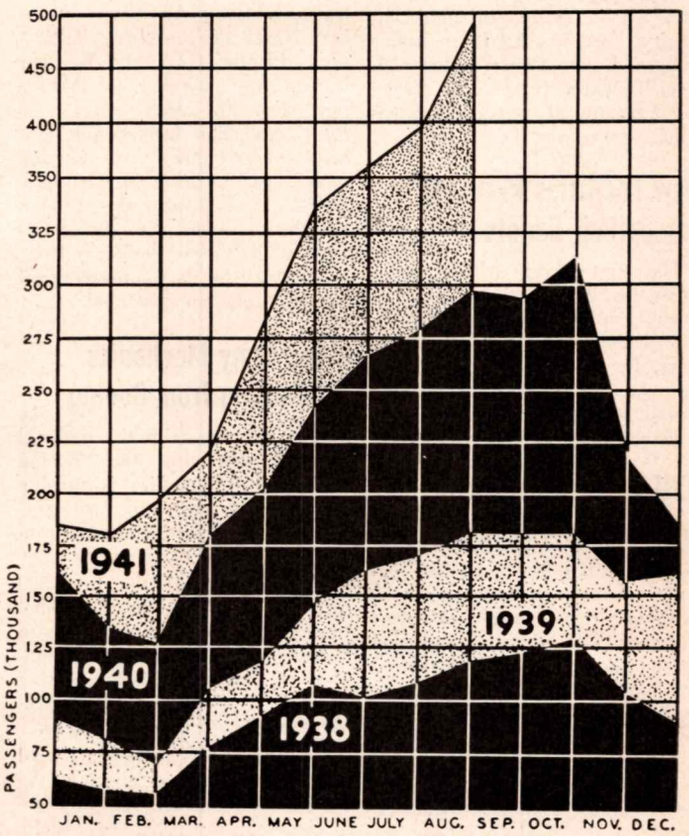
During the year ending July 1940, 76% of the earnings on the U. S.-Hong Kong-Singapore route came from mail subsidies. The Examiner did not agree with Pan American's expectation that the Clippers will be worn out in 5 years.

Civil Service Jobs

For an indefinite period, the Civil Service Commission invites applications for positions in CAA as Air Carrier Operations Inspectors and Associate Inspectors paying $3800 and $3500 per year. Applicants must possess valid airline transport pilot's certificate, extensive flying experience, and experience as first or second pilot on a certificated airline or on multi-engined aircraft used by U. S. armed forces.

Traffic controller trainee also is sought, salary $1800 a year. Applicants must have pilot's certificate of not less than private grade, or pilot rating in the armed forces. General experience may be filled by high school or college education.





Charts showing number of passengers carried and miles flown by the domestic airlines for the past three years and the first 8 months of 1941

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

SCHOOL ACTIVITIES

School Gets More Acreage

Bonham Aviation School, of Bonham, Tex., has leased two more fields for emergency use. One, north of the Revenna community, contains 200 acres and will be known as Dickey Field. The other field is six miles north of the present airport.

Cadet Prep Courses to Be Given by 14 Texas Schools

Fourteen universities and colleges of north Texas have agreed to install flying cadet preparatory courses. This is to enable high school graduates, who do not have the required college hours to meet educational requirements for aviation cadet enlistment, to prepare themselves in a nine months' course.

The schools are: Southern Methodist University, Dallas; North Texas Agricultural College, Arlington; North Texas Teachers College, Denton; Austin College, Sherman; Hardin Junior College, Wichita Falls; Hardin-Simmons College, Abilene; Abilene Christian College, Abilene; McMurray College, Abilene; Terrell Military College, Terrell; Baylor University, Waco; Texas Christian University, Fort Worth; Tyler Junior College, Tyler; Daniel Baker College, Brownwood; and John Tarleton Agricultural College, Stephenville.

New Facilities Provided For British Cadets

The first flying school exclusively for British students in the inland southwest was formally occupied Sept. 8 by Southwest Airways, Inc., when 100 students in training at Thunderbird airport moved to their new quarters, 23 miles northeast of Phoenix.

NYU Giving Courses in Communications, Electricity

Two tuition-free national defense courses covering aviation communications and electrical equipment of aircraft, approved by the U. S. Office of Education, are now being given in evening sessions by New York University's College of Engineering.

The courses, planned to meet shortages in trained personnel in the fields of aviation communications and electrical equipment are open to properly qualified graduates in engineering, and are being conducted under the direction of Dr. Harry N. Walker, chairman of the department of electrical engineering.

Staff members of the College who will conduct the classes, in addition to Dr. Walker, include Professor James M. Coburn of the Guggenheim School of Aeronautics; Professors Harold Torgersen and Philip Greenstein of the electrical engineering department.

Lectures in the course in aviation communications include general considerations of aviation communications, radio transmitter fundamentals, aircraft and ground transmitters, quieting systems, ultra-high frequency and frequency modulation reception.

The electrical equipment course includes a short review of the principles of electrical sciences.

Teach Meteorology

Six leading meteorologists have been assigned by the U. S. Weather Bureau for an indefinite period as instructors in five leading universities where the CAA has established courses for general and military meteorology. The courses are available to college graduates, Air Corps cadets and Naval officers. In collaboration with the CAA, the Weather Bureau has provided an instruction manual, *Meteorology for Pilots*, and has furnished a new form of weather map to 700 schools participating in CPT programs. In addition, the Bureau also has provided for Army Engineers its own correspondence course used by its sub-professional in-service civilian personnel.

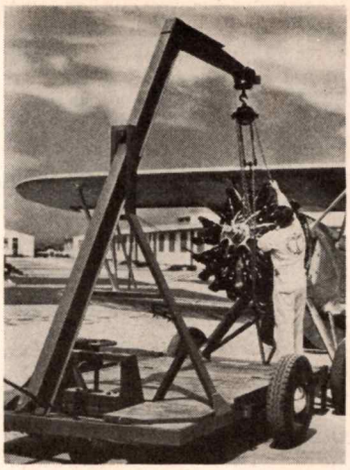
Many Army Mechanics Graduating from Boeing

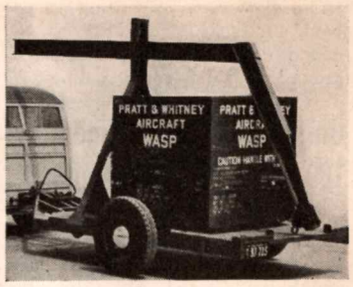
Keeping pace with the national defense speed-up, the Boeing School of Aeronautics is turning out a steady stream of Army mechanics under its training contracts with the Government.

Already, 295 of the first 500 men to be enrolled at the school have been graduated and gone to various Army air fields. Enrollment of another 500 is progressing rapidly, with groups of 25 reaching the school every two weeks.

The curriculum at Boeing School is the same as that given at the main Army school for airplane mechanics at Chanute Field,

(Continued on page 250)





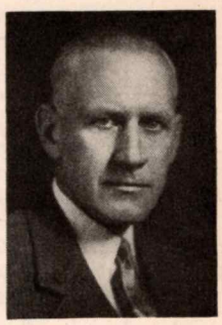
Trailer-crane developed by Boeing School of Aeronautics is easily adjustable as to height, can go almost anywhere and lift anything up to one ton. View above shows the manner in which it is attached to a car for movement around airport or from one field to another

ABOUT PEOPLE

Four important posts were filled last month at The Glenn L. Martin-Nebraska Co., the new wholly-owned subsidiary which will operate the new Martin aircraft assembly plant at Omaha. HERMAN G. KLEMM, executive engineer of the Martin company, has been named chief engineer; WILLIAM O. MACARTHUR is the comptroller; HARRY M. SHEALEY, assistant factory superintendent in charge of the Canton Division of the Martin company, is factory superintendent and CARL B. HAMLIN, chief inspector at Middle River, becomes chief inspector.

R. L. Stevens

George Carson



Harry L. Bill

N. S. LEICHTER and R. S. ROSE who co-authored *Styling Aircraft Interiors* which appeared in the October, 1941 issue of AERO DIGEST are consulting engineering stylist, and equipment design engineer, respectively for Lockheed Aircraft Corp.

Appointment of EARL C. MAUND in a sales and engineering capacity at their Chicago office, was announced last month by Manning, Maxwell & Moore, Inc. Maund's engineering services will cover the products of Consolidated safety valves, Hancock valves, American instruments and Ashcroft gauges.

At a meeting of the board of directors of the Greenfield Tap and Die Corp., last month, HARRY L. BILL was elected vice-president and general manager to succeed HOWARD M. HUBBARD, recently resigned. Bill will be remembered as president and general manager of United Aircraft Products, Inc., which he left to join Greenfield.

ROBERT L. STEVENS, who has been associated with Bell Aircraft Corp., since February as assistant to works manager LESTER L. BENSON, has been appointed plant engineer, succeeding HENRY K. BEEBE, SR., resigned. Assisting Mr. Stevens will be GEORGE CARSON.

N. B. RADER, interline traffic manager for United Air Lines, has been named San Francisco district

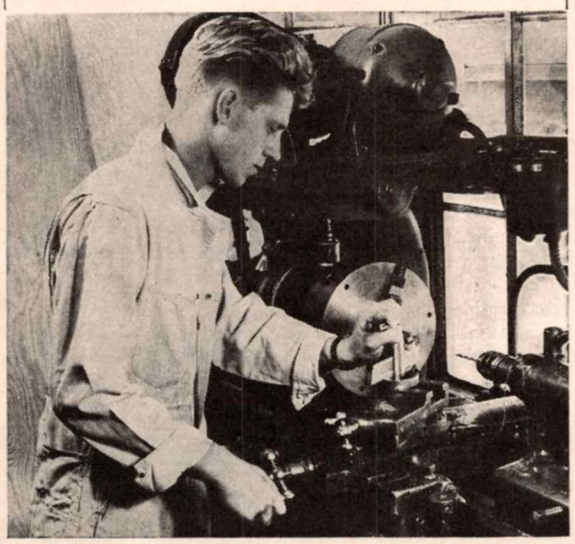
(Continued on following page)

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

Here are two young men entering the aviation industry

This Young Man

has taken a job at what appears to be good wages for a beginner



This Young Man

has entered Boeing School of Aeronautics to train himself for a career

Who is most likely to succeed . . . which one will be first to hold a top position in the aviation industry?

If you study the aviation industry you will find that there is a growing demand for men who are thoroughly trained and educated in the *theory and practice of aeronautics.*

You can't get this training in an aircraft plant as a mere job holder. The only place you can get it is at a school that has a reputation for developing men for positions with the airlines and the more specialized fields of aeronautical engineering. And Boeing School of Aeronautics is just that kind of school!

Boeing School, which is a division of the United Air Lines, offers courses covering every phase of aviation plus the most modern equipment. It is constantly in touch with the industry and knows what its needs are in trained men. And what is most important to you—*there is always a demand for Boeing School Grads.* This year the call for them has been greater than the supply.

Don't let the temptation of getting a pay check now, swerve you from enrolling in Boeing School of Aeronautics—the step that will pay you bigger returns in the future. One thing is certain—you owe it to yourself to investigate how Boeing School of Aeronautics can train you for a career in aviation. Start this investigation now by mailing the coupon.

ENROLLMENT PERIODS: JANUARY, MARCH, JUNE, SEPTEMBER

8 CAREER COURSES One specially designed to fit your chosen field of aviation. Note the courses requiring only high school education:

Courses requiring High School only

- ☐ Airline Pilot and Engineering
- ☐ Airline Operations and Engineering
- ☐ Airline Mechanic and Operations

- ☐ Aeronautical Engineering
- ☐ Airline Mechanic
- ☐ Aircraft Sheet Metal
- ☐ Private Pilot
- ☐ Commercial Pilot

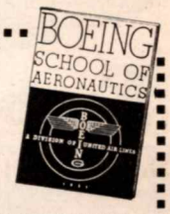
Advanced Courses

- ☐ Air Transport Engineering
- ☐ Airline Pilot Course
- ☐ Airline Technician
- ☐ Airline Meteorology
- ☐ Special Airline Pilot
- ☐ Instrument Rating

NOTE: Link trainer and modern multi-motor instruction available.

Boeing School of Aeronautics
2111, Hangar No. 5
Airport, Oakland, California.

GENTLEMEN: Please mail me—without charge—the Boeing School descriptive booklet containing complete information on the school and describing in detail the courses I have checked at the left.



Name .....

Street Address .....

City .....

State ..... *Age* .....

Previous Schooling .....

BOEING SCHOOL OF AERONAUTICS EST. 1929 A DIVISION OF UNITED AIR LINES

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

The man who succeeds is the man who takes careful aim—who knows where he wants to go, and makes the most of his opportunities to get there! To you whose future is in Aviation, today represents an unequalled opportunity. To you who recognize that opportunity, Embry-Riddle training is the means to get the right start towards success. There are Embry-Riddle technical and flying courses to prepare you for your place in Aviation—in the air or on the ground.

SUN and FUN while you learn!

Not only the best in aviation training—but the fun of living while you learn in sunny Florida. Year-round sunshine, beaches, outdoor sports. Aviation thrills in the air gateway to Latin America. Clip the coupon today for full information, enroll now for your Embry-Riddle aviation course

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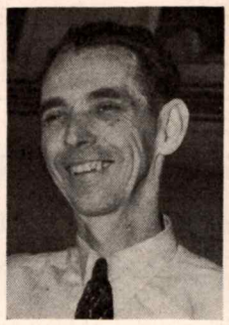
Contractors to U. S. Army Air Corps and Civil Aeronautics Administration

Reay Jones



R. F. Meardon

Wally Smith

(Continued from preceding page) traffic manager for United as successor to S. A. STIMPSON.

The election of DONALD N. McDONNELL, as a director of Vultee Aircraft, Inc., was announced last month by HARRY WOODHEAD, chairman of the board. McDonnell is vice-president of Blyth & Company and has been in the banking and investment business since 1922. He is a native of Seattle, attended the University of Washington and Harvard University.

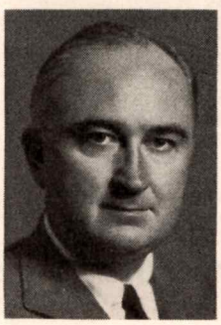
Promotions for three members of the staff of Transcontinental & Western Air, Inc., effective Oct 15, were announced by PAUL E. RICHTER, executive vice-president.

REAY JONES advances from system chief clerk, traffic and sales department, to assistant personnel manager under Manager LES M. REED. E. P. LEPPER assumes Jones' former post, while H. B. OBERMILLER, assistant personnel manager, is now assistant auditor. He also handles special assignments.

The airline also appointed WALLY SMITH as the district manager at Honolulu.

Delta's new public relations director is STANLEY WEBBER, formerly with the Ingersoll Rand Co. in the United States and Mexico.

ROBERT F. MEARDON, former general foreman of line maintenance in New York, has been promoted to the position of maintenance supervisor in Chicago for American Airlines.



D. N. McDonnell

N. B. Rader

Stanley Webber

First U. S. miltary pilot, MAJ. GEN. FRANK P. LAHM has been named Commanding General of the Gulf Coast Air Corps Training Center, with headquarters at Randolph Field. Scheduled to retire this month by virtue of reaching the statutory age limit of 64 years, Gen. Lahm is the father of the present unified Air Corps pilot training system.

R. S. Boutelle (See pg. 84)

Maj. Morris (See pg. 83)

Maj.-Gen. F. P. Lahm

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

EXPORT NOTES

Cubs Used to Carry Mail In Dominican Republic

Regularly scheduled air mail routes have been established by the Dominican Republic with light plane equipment following the recent delivery of four Piper *Cub Cruisers.*

The order for the *Cruisers* was placed for the Republic by Colonel C. A. McLaughlin, a high ranking official of the Dominican Army. It is understood that the planes will operate from small airports in sections of the country where ground transportation is slow and uncertain. They have an allowable cargo load of 340 lb, and removal of the rear seat and installation of a cargo bin allows ample room for bulky packages. With 25 gal gasoline capacity, the ships have sufficient reserve for a range of about 450 miles.

Latin American Students To Be Trained Here

Details were released last month of a plan for increased cooperation among American Republics which will bring young men from below the Rio Grande to be trained as pilots and aviation technicians in the United States, beginning shortly after the first of the year.

The program will be under the sponsorship of an Interdepartmental Committee and the courses will vary from six months to two years. It calls for the initial training of 275 pilots, 18 administrative engineers, 87 instructor mechanics, and 120 airplane service mechanics, each pledged in advance to a career in commercial aviation.

The Committee, known as the Interdepartmental Committee on Technical Aviation Training for Citizens of the Latin American Republics, consists of William Barclay Harding, vice-president, defense supplies Corp., also representing Coordinator of Inter-American Affairs, Thomas E. Burke, Chief, International Communications Division, State Department; Maj. Eugene E. Gillespie, Air Corps, War Department, also representing Navy Department; G. Grant Mason, Member, Civil Aeronautics Board; and Brig.-Gen. Donald H. Connolly, Administrator of Civil Aeronautics.

Pilot training will be under the supervision of the Army Air Corps and the CAA. The 75 Army trainees will take the regular Air Corps Training, with the exception of military subjects, while the 200 CAA trainees will learn flying at approved certificated schools. The CAA will also carry out all the mechanic training in a similar fashion.

Export Business Adds To Fairchild's Output

The Fairchild Aircraft factory and hangars at Hagerstown last month looked like the center of anti-axis air activity when pilots or officials from Brazil, Ecuador, Bolivia, England, Norway, the United States Air Corps and the CAA, as well as representatives of various operators and schools all visited the plant either to take delivery of Fairchild 24 cabin planes and Fairchild M-62 Trainers or to see their orders start through the factories.

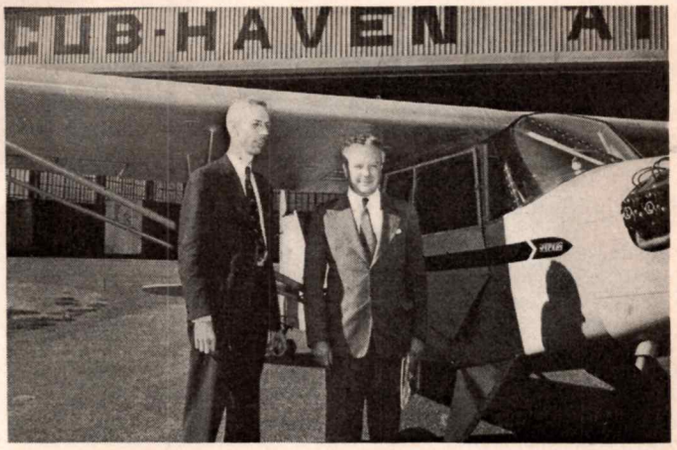
One of the most interesting developments was the scheduling of four trainers, the first of a larger order, for the Ecuadorean government. These trainers will be powered by a 200 hp Ranger engine.

Four members of the Bolivian Air Force, headed by Colonel Moscoso, visited the plant with Major E. H. Porter, (USA) who soon leaves for Bolivia to head a new U. S. Military Aviation Mission. As a result of this visit three PT-19 Trainers, the U. S. Army designation for the M-62, were shipped to Bolivia for use by this mission in demonstration and training flights.

Fifteen Fairchild 24s with the Warner 145 were also put into production for the government of Brazil, while a twelfth of a similar ship on a large order for the British was completed and crated for shipment. In addition, five PT-19 Trainers with the Ranger engine were delivered to the Norwegian pilots who, under Major Ole Riestadt, are training at Island Airport in Toronto. The Norwegians have been using a fleet of twenty PT-19s for almost a year and, as soon as these five were completed and delivered, they ordered another five which were scheduled for immediate production.

Seeks Representation for Products in Australia

Paul & Gray, Ltd., leading aircraft parts suppliers of Australia, are endeavoring to add to their agency the representation of American aircraft, engine and accessory manufactures, according to Alan T. Anderson, general manager.



Comdr. Carlos Montecino A., Director of Aeronautics in Chile, visits the Piper factory. He is shown here with Ted Weld (left), Piper vice-president

First approved aircraft parts suppliers in Australia, the company has branches in the four principal cities and at Mascot and Essendon airport, the latter two having been taken over by the RAAF when war broke out. The firm's principal office is in Sydney.

Frank Gannon, organizer and manager of the aircraft parts division, is now organizing the overseas agencies. He recently was with the Australian Aircraft Production Commission as Parts Purchasing Manager.

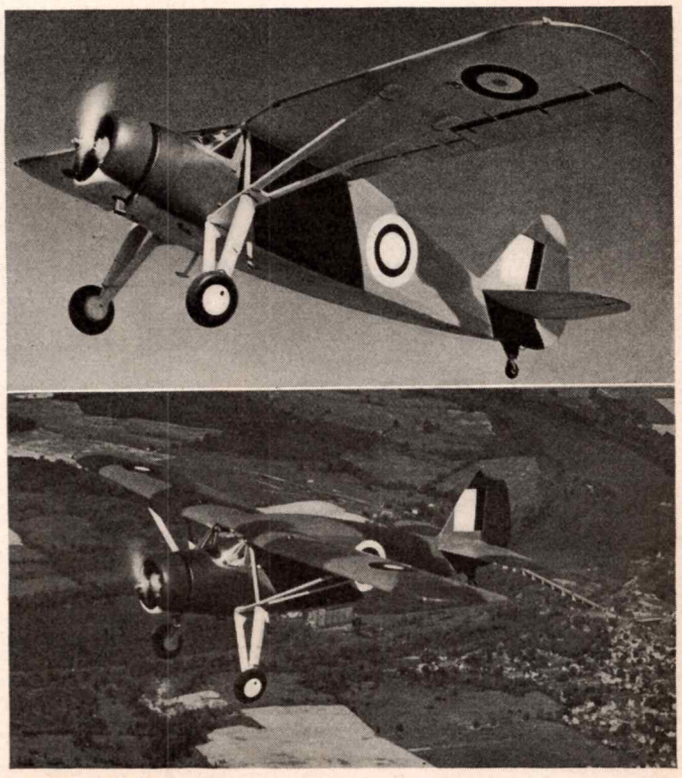
August Export Licenses

Latest State Department reports reveal licenses were issued in August for export of military planes, engines, and aircraft parts, presumably chiefly to Allied war nations, for a total of $196,344,956, bringing the total for the eight months ending in August to $871,177,415. Actual exports for the eight months totalled $300,907,354.70; for the month of August, $35,270,287.32.

Bomber Order Placed By Netherlands Indies

Contracts recently negotiated between North American Aviation and the Netherlands Purchasing Commission have provided for the construction of NA-40B twin-en-

(Continued on page 110)



These Warner-powered Fairchild F-24 monoplanes are being used for pilot ferrying work in Great Britain by the Royal Air Force

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

FINANCIAL BRIEFS

Financial Reports

Continental Motors Corp., Muskegon, Mich, reports a net profit of $2,236,164 after all charges including Federal income taxes, excess profits taxes, and depreciation, after allowing reserves and charge-offs for the nine-month period ending July 31, 1941.

* * *

Northrop Aircraft, Inc., reports for its second fiscal year to July 31, 1941, a net loss of $848,778.

Northrop now ranks thirteenth in the volume of its backlog of unfinished orders. As of October 1, 1941, orders on hand totaled $74,873,159. Of this amount, $60,553,193 was orders placed by the United States Army and Navy and Great Britain, and $14,319,966 was represented by sub-contracts. The total backlog compares with unfilled orders of $20,617,586 as of October 6, 1940.

* * *

Representing the first profitable fiscal period in the company's history, Menasco Manufacturing Co., last month reported for the year ended June 30, last, net earnings of $183,605 after all charges compared with a new loss of $190,136 in the preceding year.

Net sales for the year totaled $2,187,345, including $1,886,526 from Burbank plant operations and $300,820 from the McKinley Ave. foundry, compared with net sales of $383,984. This was a gain of $1,803,362.

* * *

A net profit of $1,459,649 in the nine months ended on Aug. 31 was shown by the Aviation Corporation and subsidiaries after charges for depreciation and income taxes.

The result is equivalent to 33 cents a share on 4,366,667 capital shares and compares with $72,854 or 2 cents a share on 3,951,667 shares in the nine months ended with Aug., 1940. Unfilled orders on Aug. 31 amounted to $16,621,342.

* * *

Kellett Autogiro Corp., last month announced third quarter sales totalling $484,015 as against sales of $135,677 during the same period a year ago. Sales for the nine months' period amounted to $1,116,794 compared with $425,977 during the first nine months of 1940 and $738,478.61 for the entire year of 1940. Major portion of the business has been for bomber, pursuit and fighter parts.

Unfilled orders on Sept. 30 were $3,092,603.

* * *

Consolidated Aircraft Corp., and subsidiary for the eight months ended August 31, 1941, reported sales at $52,684,549; and net income of $3,611,015, after taxes and charges, equal after preferred dividends, to $5.57 a share on 641,187 common shares.

New Companies

Midway Airport Corp., Fort Worth, Tex., has been incorporated for the purpose of manufacturing, under the laws of the State of Texas. Capital stock is $10,000, and incorporators are Raymond E. Buck, Frank J. Knapp and Hollis R. Thompson.

* * *

Globe Aircraft Sales Corp., Fort Worth, has been incorporated under the laws of the State of Texas for the purpose of manufacturing planes. Incorporators are Alex Taynes, Bruce Sullivan and J. Harrington Kennedy.

Dividends

Fourth dividend to be paid this year was voted last month by the directors of Kinner Motors, Inc. The dividend is for 5 cents a share and is payable on Nov. 15 to stockholders on record on Nov. 1.

Five-cent dividends were paid on Feb. 15 and May 15, and a 10-cents dividend was paid on Aug. 15. Kinner's current backlog is about $3,500,000.

* * *

Directors of the Curtiss-Wright, and Wright Aeronautical Corporations last month announced new dividends, each twice that of previous payment. Curtiss-Wright paid $1 on the common stock on Oct. 17, and Wright paid $8 a share on Oct. 20.

Beech Backlog 88 Million

Present backlog of undelivered orders of Beech Aircraft Corp., now totals over $88,000,000, of which approximately 93% is for two types of airplanes.

Preliminary unaudited figures indicate that deliveries during September 1941 totaled over $1,886,000.

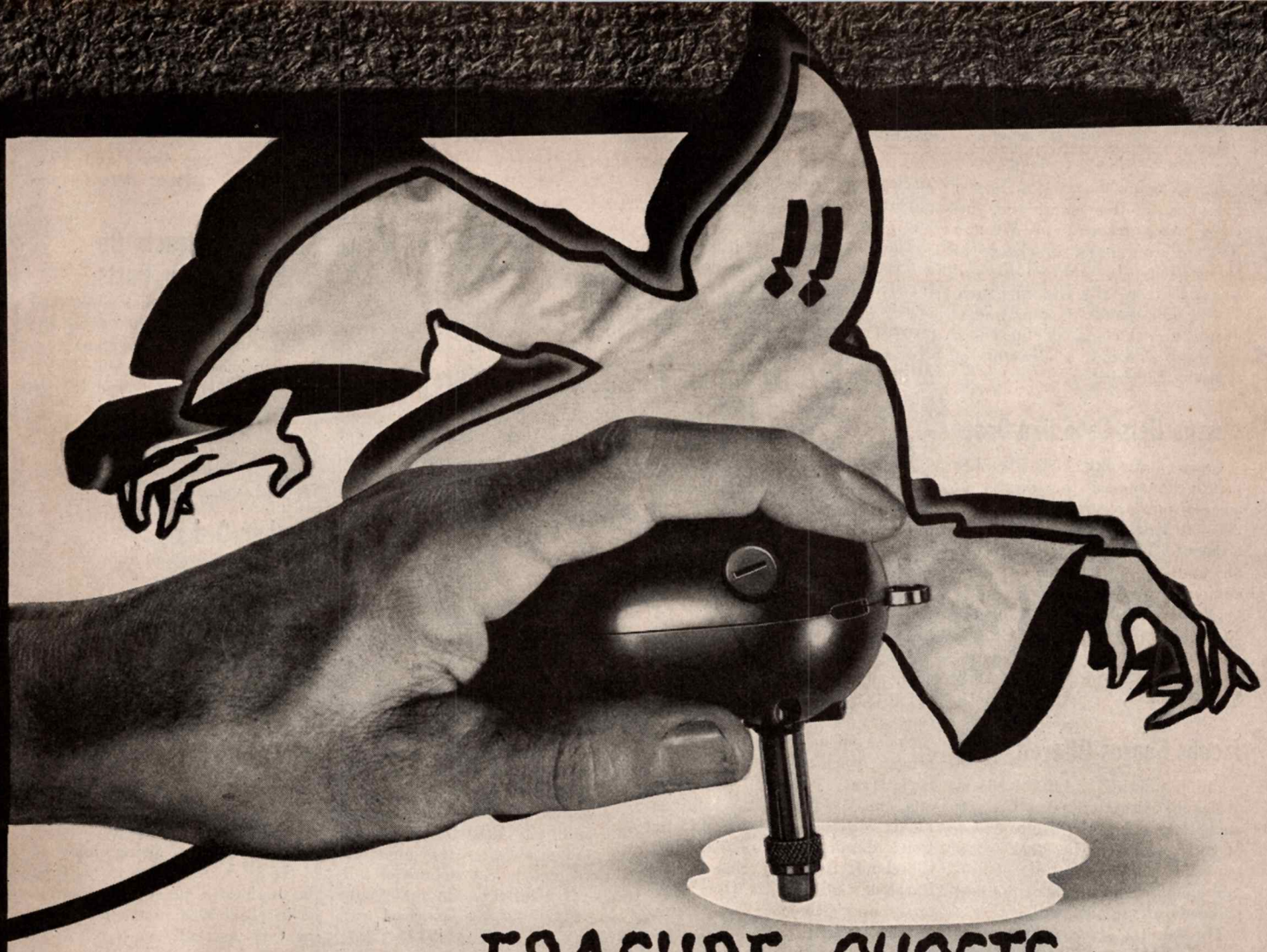
WE Merges Subsidiary

Announcement was made last month by C. G. Stoll, president of the Western Electric Co., that its wholly owned subsidiary, Electrical Research Products Inc., is to be merged into the parent company about November 1. Domestic activities thereafter are to be carried on as the Electrical Research Products Division of Western Electric.

(Continued on following page)

	Week Ending September 27				October 4				October 11				October 18				Closing Oct. 21			
	High	Low	Change	Sales	High	Low	Change	Sales	High	Low	Change	Sales	High	Low	Change	Sales	High	Low	Last	Ch'ge
N. Y. STOCK EXCHANGE																				
American Airlines	47¾	45¼	— ⅞	2,600	48½	46½	+ ¾	2,900	47¼	45½	+ ½	2,800	48	46¼	+ ¾	2,800	.....	.....	.....	.....
Aviation Corp.	4¼	3⅝	— ¼	42,600	4	3¾	+ ⅛	9,200	3⅞	3½	— ¼	12,500	3⅝	3¼	— ⅛	21,600	3⅝	3½	3⅝	— ⅛
Bendix Aviation	40¼	37	—1¾	8,000	38⅝	37⅝	+ ½	5,700	38½	36⅝	—1⅞	6,700	37	35⅝	+ ⅜	4,800	37⅞	37¼	37⅞	— ⅛
Boeing Airplane	23½	20⅛	—1	36,900	22	20¾	— ⅝	10,400	21	18⅝	— ⅞	24,100	20½	18¼	— ⅛	15,800	20⅝	20	20⅝	— ⅝
Consolidated	49⅝	42⅛	—3⅝	33,100	44¼	42½	.....	7,800	42¾	36⅞	—4	14,400	39½	36	+ ¼	14,000	.....	.....	.....	.....
Continental Motors	3⅞	3⅜	— ¼	11,800	3⅝	3⅜	+ ⅛	4,000	3⅜	3⅛	— ⅜	9,300	3⅝	3¼	+ ⅜	16,500	3½	3⅜	3½	.....
Curtiss-Wright	10⅛	9	— ⅜	51,200	9⅝	9¼	+ ⅛	19,200	10⅛	9	+ ⅝	87,800	10⅛	8⅛	— ⅜	80,400	8⅝	8½	8½	+ ¼
Curtiss-Wright A	27⅜	26⅛	— ¼	4,000	26½	26	— ½	1,900	26⅝	25¼	— ¼	2,600	26	24⅜	— ¼	3,400	25¾	25½	25¾	— ¼
Douglas Aircraft	78¼	72¾	—3	5,900	75¼	73¼	+ ½	2,300	75	71	—1¾	4,200	74½	70¾	+2¼	3,100	75¼	74½	74¾	— ½
Eastern Airlines	31½	28¼	— 1¾	4,000	31	29¾	+ ⅝	2,900	31	29⅝	—4	5,100	31	29½	+ ⅛	3,700	30⅞	30½	30⅛	+ ⅛
Grumman	17	15½	—1	2,000	15⅞	15½	— ½	1,500	15½	14⅛	— ½	1,600	14½	13¼	+ ¾	2,400	14¼	14⅛	14¼	.....
Lockheed	30¾	26¼	—1⅛	27,400	28⅞	27⅞	+ ⅜	9,900	28½	26¼	— ¾	11,100	27¾	25⅝	— ¼	7,400	28⅛	27¼	28	— ½
Martin, G. L.	30¼	27½	—1⅜	11,400	28¾	27¾	— ¼	3,300	28	25⅞	— ⅝	4,600	27⅜	24¾	—1⅜	6,600	27⅜	26½	27⅜	—1⅛
National Aviation	9¾	9¼	— ¼	2,100	9¾	9⅜	.....	1,000	9⅜	9	— ⅜	1,800	9⅛	8⅝	.....	2,800	9	9	9	.....
North American	16	14¼	— ⅞	11,900	15⅛	14½	— ⅛	3,000	14½	13⅛	— ¾	10,500	13⅞	12⅞	.....	7,700	13⅝	13½	13⅝	+ ⅛
Northwest Airlines	12	11	— ½	500	12½	11⅝	+1	2,300	13¼	12	+ ½	7,600	13	12	— ⅛	3,500	13¼	13¼	13¼	— ⅜
Pan American	17½	16	— ⅝	16,600	17¾	16¾	+ ⅞	7,400	17¾	16½	— ½	13,100	16⅞	15⅝	— ¼	9,300	16⅞	16¼	16⅞	— ⅛
Sperry Corp.	38¼	35¼	—2¼	5,300	35¾	35	.....	3,200	35⅜	33⅛	—1⅜	5,000	34	32⅜	— ⅝	4,100	33⅜	33	33⅜	+ ⅛
Square D. Corp.	39⅞	38½	— ½	1,500	39⅛	38⅝	+ ⅛	3,000	38½	37¼	—1⅞	1,800	37	35½	—1¾	1,300	.....	.....	.....	.....
Square D Corp. pf.	114¾	114¼	— ¾	60	114¼	114¼	+1¼	20	.....	.....	.....	.....	.....	.....	.....	.....	113¾	113¾	113¾	.....
TWA	13⅞	12¼	—1¼	900	13⅝	12¾	+ ⅜	1,400	14⅜	13	+1	2,700	14⅛	12¾	— ¾	2,300	13½	13½	13½	— ¼
United Air Lines	13⅞	11¾	— ½	13,100	13⅝	12⅜	— ¼	5,700	14⅛	12⅝	+1⅜	22,300	14	12⅞	— ⅜	5,800	14⅛	14	14⅛	— ⅜
United Aircraft	40¼	37½	—1⅝	10,000	38½	37⅝	— ¼	5,500	37⅝	36	— ¾	7,100	38	36	+1	6,000	37¼	36¼	37¼	+ ¾
Wright Aero	108	105	—4	50	.....	.....	.....	.....	109½	103½	+2	140	109½	108	.....	190	.....	.....	.....	.....
N. Y. CURB EXCHANGE																				
Aero Sup. Mfg. A	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22	22	+ ⅞	100	.....	.....	.....	.....
Aero Sup. Mfg. B	5⅞	5⅛	— ½	1,300	5⅜	5¼	— ⅛	600	5¼	5	— ¼	800	5⅛	5	.....	100	.....	.....	.....	.....
Air Associates	.....	.....	.....	.....	8⅜	8¼	— ⅝	300	8⅛	8⅛	— ⅛	200	7¾	7¾	— ⅜	200	.....	.....	.....	.....
Air Investors	1¾	1⅝	.....	900	1⅝	1⅝	.....	100	1⅝	1½	— ⅛	800	1⅜	1⅜	— ⅛	200	1⅝	1⅝	1⅝	— ¼
Beech Aircraft	11⅛	9	— ⅝	11,600	10¼	10	.....	3,700	10	9⅛	— ¼	3,800	9⅝	8⅞	— ½	5,200	9¾	9½	9¾	— ½
Bell Aircraft	18½	16⅞	+ ⅛	4,800	18½	17¾	— ⅜	1,900	18⅝	16¾	— ⅞	2,800	17⅛	15½	.....	2,000	17½	17	17½	— ½
Bellanca Aircraft	.....	.....	.....	.....	3⅜	3¼	— ⅝	900	3⅛	3	— ⅛	300	3⅛	2⅞	— ⅛	500	.....	.....	.....	.....
Breeze Corp.	11¼	9½	—1½	2,900	10¼	10	+ ¼	1,500	10⅛	9¾	.....	1,200	10	9¾	.....	1,100	10¼	10¼	10¼	— ¼
Brewster Aero	11	9¼	—1¼	7,000	10⅝	10	+ ½	2,700	10⅛	9	— ⅞	2,000	10⅜	9¾	+ ¾	5,900	10⅜	10⅛	10⅜	— ⅜
Can. Col. Airways	3½	3	— ⅝	700	3⅝	3⅛	+ ½	600	3¾	3	— ⅛	2,800	3¼	2¾	— ⅜	700	3	3	3	.....
Cessna Aircraft	11½	8¾	—1	11,000	11½	10¾	+1¼	3,900	11¼	9¼	—1⅛	4,400	10⅛	8¾	— ⅜	5,000	10¼	10	10⅛	— ⅜
Fairchild Aviation	11½	9¾	—1½	1,200	10¼	10⅛	+ ½	200	9⅞	9	— ¾	1,000	9¼	8¾	— ¾	700	9⅜	9⅛	9⅜	— ⅝
Fairchild Engine	3⅝	3¼	— ¼	3,700	3½	3¼	— ⅛	1,600	3¼	2⅞	— ¼	3,700	2⅞	2¾	— ⅛	2,100	2⅞	2⅞	2⅞	.....
Irving Air Chute	11¼	10⅝	— ⅛	700	.....	.....	.....	.....	10⅝	9	—1⅝	600	9⅜	9⅛	— ⅜	500	.....	.....	.....	.....
Penn-Central	12½	10⅝	—1⅞	1,300	12¼	12¼	+1⅝	300	12	11	— ¼	1,700	11¾	11	—1	1,300	10⅞	10⅞	10⅞	+ ⅛
Republic Aviation	5	4⅜	— ⅜	5,000	4⅝	4⅜	+ ⅛	3,600	4⅝	4	— ¼	5,200	4⅝	4	.....	6,500	4½	4¼	4½	— ⅛
Roosevelt Field	.....	.....	.....	.....	.....	.....	.....	.....	2⅛	2⅛	— ¼	200	.....	.....	.....	.....	.....	.....	.....	.....
Ryan Aero	5⅝	4½	— ⅜	2,400	5	4¾	— ⅛	300	4¾	4⅝	— ¼	200	4½	4¼	— ¼	800	.....	.....	.....	.....
United Aircraft Products	9⅝	8¾	— ⅞	1,400	9	9	+ ¼	100	.....	.....	.....	.....	8¾	7⅞	— ¼	300	.....	.....	.....	.....
Vultee Aircraft	11¼	9½	— ⅝	17,400	10¼	9¾	+ ½	3,600	10	9	— ¾	3,700	9⅛	8⅛	— ⅛	2,600	9¾	9½	9½	— ⅜
Waco Aircraft	7	6	— ⅜	1,500	6⅛	6⅛	.....	300	6	5½	— ¼	600	5½	5	— ⅜	500	.....	.....	.....	.....
Western Air Lines	4⅜	4	— ¼	700	.....	.....	.....	.....	4⅜	4	.....	1,000	4⅜	4	— ⅜	300	.....	.....	.....	.....

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



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for pencil *and* ink

(Continued from preceding page)

T. Kennedy Stevenson, former president of the subsidiary, becomes vice-president of Western Electric, continuing in charge of this activity. In addition he will direct the general accounting, treasurer's and secretary's departments of the parent company. Stevenson was also elected a director of Western Electric.

Cessna Gets Canadian Order

Cessna Aircraft officials last month announced the receipt of an additional contract totaling $3,273,630 from the Canadian government. The contract calls for an undisclosed number of twin-engined advanced trainers, similar to those already ordered for the RCAF.

The company's backlog as of Sept. 1, 1941, was approximately $31,000,000.

Jacobs Shares Offered

Public offering of 140,000 shares of Jacobs Aircraft Engine Co. was made last month by Riter & Co. at $5.25 a share. The stock is being sold for the accounts of certain stockholders to whom the new proceeds of the sale will go.

The capital stock of the company is of $1 par value and is the company's only authorized class of security. There are 618,546 shares outstanding of the 750,000 shares authorized.

Uniloy Contracts to Make British Oxygen Regulators

Award of a $1,010,000 contract to Uniloy Accessories Corp., of Lancaster, N. Y., for oxygen regulators to be installed on British aircraft threw the spotlight on a manufacturing business which was founded nine years ago in the basement of its president's home.

Earle M. Scott, president of the company, said his company now is going into production on a relatively large scale and is expanding plant facilities.

"We started nine years ago," Mr. Scott recalled, "making light aircraft tail wheel assemblies on a part-time basis in my basement and garage."

The corporation has been filling a $25,000 order for compass cases for British fighting planes. It also makes assembly parts for various aircraft manufacturers.

Aviation Defense Spending Nears Billion in Month

Between the middle of August and the middle of September, expenditures and appropriations for aviation purposes, specifically for the Army, Navy and CAA, totaled $909,931,172, including $251,949,898 worth of items covering construction and aeronautical nonplane equipment for Army and Navy.

Army construction and equipment purchases or allocations total $119,643,898. Some of the major contracts benefit cities and towns such as Waco, Tex.; St. Paul, Minn.; Wichita Falls, and Lubbock, Tex.; Wellston, Ga.; Marietta, and Middleton, Pa.; Ellington Field; Milwaukee; Baltimore; Detroit; Morain and Vandalia, Ohio; Cleveland; Briston, Conn.; Dallas; Burbank, Calif.; Tulsa, Okla.; Victoria, and Mission, Tex.; Santa Monica, Calif.; Kelly Field, Tex., and Dayton. Ninety-six towns and cities, in every State, receive either factories, flying fields, or receive business that spreads money widely in the community.

In addition the Army Air Forces spent $652,021,274 for planes and parts in ten plants, Boeing leading with two orders totalling $337,447,058; Douglas came next with one order totalling $176,316,690. Bell received an order for $75,218,384, Wright for $19,268,820, Cessna $12,043,865, and various substantial orders were given to Fleetwings, North American, Jack & Henitz, and various other firms.

Navy allocations for new fields and improvements, structures and similar aeronautical bases and structures, totaled $138,306,000. Sitka, Unalaska, Whidby Island in Washington, Wake Island, Long Beach in California, Hawaii, Philippines, Corpus Christi in Texas, Jacksonville, Kodiak, Midway Island, Norfolk, Bermuda, Virgin Islands, Johnston Island, Miami, Newfoundland, Trinidad, were the principal beneficiaries among 56 different communities.

The first supplemental appropriation law gave the Bureau of Aeronautics $90,000,000; Army Air Corps, $204,007,800; the CAA, $12,186,000.

CAA received $6,686,000 for air navigation facilities, $500,000 of which is specified for airport traffic control towers, and $5,500,000 for development of landing areas.

Navy appropriations contained an item of $100,000 designated for "experiments and exploration of the utility of rotary-wing craft, gliders, metal hulled craft, and other than conventionally propelled lighter-than-air craft."

Jacobs Deliveries in One Month Exceed 1940 Total

Jacobs Aircraft Engine Co., Pottstown, Pa., reports that, in the month of August, it exceeded the full year 1940 in production, in number of aircraft engines delivered, and in net amount of billings. Net billings for the month were $1,505,405, as compared with $1,386,271 for all of 1940.

Production is currently running about 2000% more than when the first important defense contract was received.

Delivers 2000th Trainer

Completion of its 2000th primary training plane under the emergency defense program was announced late in August by the Stearman Aircraft Division, Boeing Airplane Co., Wichita, when the airplane was turned over to the U. S. Army Air Corps. Accepted by Lieut. Col. Ray G. Harris, Air Corps representative, its delivery, considerably ahead of schedule, was declared by Boeing officials to be indicative of an enthusiastic production effort on the part of employees. The Stearman plant was believed to be the first to complete this number of airplanes for the Army and Navy under the national defense program.

Bell Subcontracts On Boeing Bomber Parts

Bell Aircraft Corp. has received orders totaling $12,500,000 for the construction of bomber-plane control surfaces and tail sub-assemblies from the Douglas and Vega companies. The parts to be made by Bell acting as a sub-contractor will be used in the assembly of Boeing Flying Fortresses by Douglas and Vega.

Bomber Order

(Continued from page 107)

gine, medium bombers and spare parts for the Netherlands East Indies Army Air Corps. While the number of planes involved was not revealed, the total value of the contract was set at approximately $24,000,000. The order is the first placed by the Netherlands government with North American, and is also the first export order accepted for the NA-40B type.

NA-40B is the export model essentially similar to the B-25 medium bombers now being delivered to the U. S. Army Air Corps from the Inglewood plant, and soon to be in production in the new Kansas City Assembly unit. NA-40B's for the Netherlands will be produced in the company's Inglewood plant.

When deliveries begin in 1942, the planes will be flown across the Pacific Ocean to the Netherlands Army Bases.

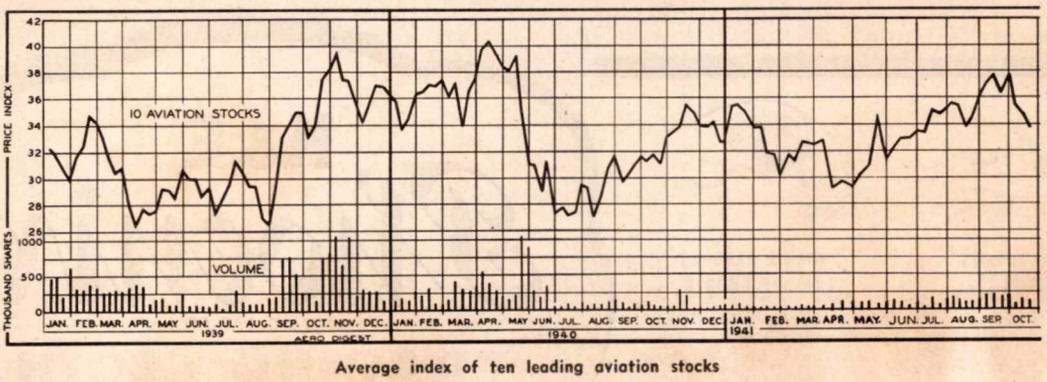
Representing the Netherlands government at Inglewood during contract negotiations has been Major E. J. G. TeRoller of the Netherlands Purchasing Commission.

Air Force Enlarging

(Continued from page 82)

squadrons and put into being 84 instead of 54 combat groups as now organized. The Army's original program provided for a force of 25,000 planes. Eighteen months ago the Army's air force totaled 50,000 men. Mr. Stimson did not indicate how many aircraft would be provided for the enlarged force.

The suggestion for increasing the size of the Air Forces so that they constitute a major branch of the Army immediately brought praise from independent-air-force advocates who felt the tremendous expansion will be of material strength to them when they present their case in Senate committee hearings this month. While the Air Force has a greater measure of autonomy than before and this autonomy will probably be expanded, proponents of an independent air force see the need for a separate division now as a result of the expansion plans.



Average index of ten leading aviation stocks

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

Briareus, Machinist?

With his hundred arms the mythical giant Briareus no doubt could have accomplished a great deal of work . . . say as a lathe operator. ¶There is no information, however, that Briareus was a brainy fellow and that he could skillfully employ any one of his hundred arms. ¶Here at Collins we believe that fine craftsmanship does not arise alone from good tools or keen workmen but is a result of the coordination of both. ¶Our factory, equipped with modern machine tools, utilizes nearly every process for the finished fabrication of transmitter materials. Processing not satisfactorily procured from outside sources is done in our own plant; thus, we are able to control quality and to speed production. ¶Complementing our equipment is a large corps of highly skilled workmen who know how to use the tools to advantage. These men are instilled with the idea of doing the best possible job. They are inspired to have achieved the highest standard of craftsmanship.

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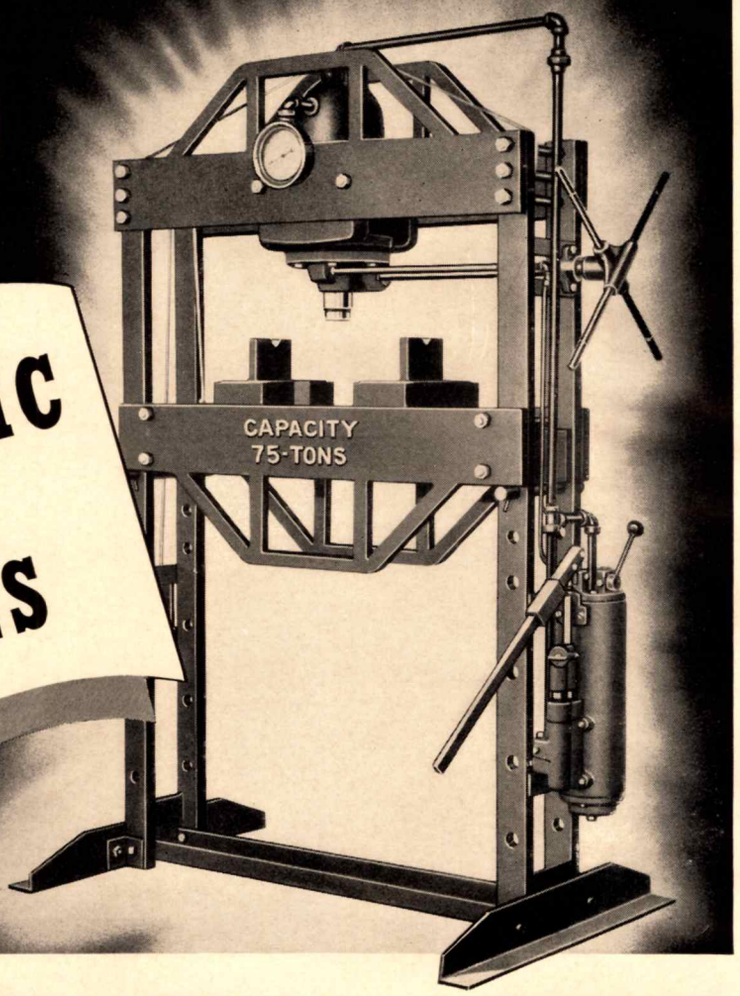

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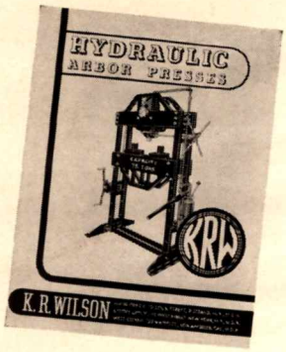

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AVIATION ENGINEERING

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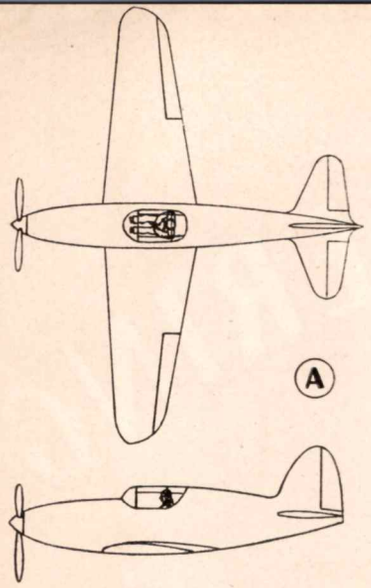
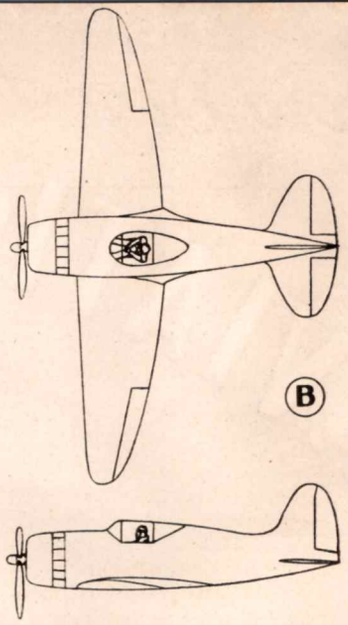
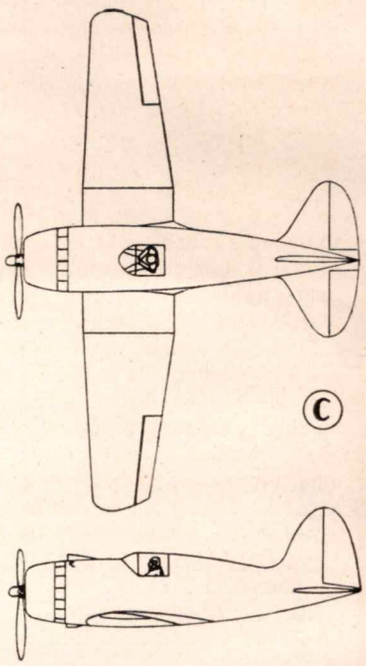
Night shift at the Bell Aircraft Corp.'s assembly plant, Niagara Falls, N. Y., working on the second power-driven assembly line of "Airacobras" which has just been placed in operation



RANGE and STRIKING POWER of the FIGHTER

PEYTON AUTRY





● The fighter has come into a being all its own, but it is rather uncertain to predict just what this is or will consist of because there appears to be a wide variation from past design trends of these military aircraft. Recent or expected aerial tactics have wrought extensive changes in the requirements of all military aircraft, and the fighter is by no means an exception. In addition, at present, there seems to be no fundamental concept as to what makes up the ideally suited fighter airplane.

However, the tactical utility of a design having good range, striking power and speed can hardly be questioned as a potent offensive air weapon. The increasing range of heavy bombers makes the range requirement greater on the fighter which must intercept the larger ship. This problem can be important where geography or other limitations restrict the number of bases. The fighter must be able to intercept or overtake its objective or adversary in the shortest possible time, then strike effectively and quickly and have sufficient fuel remaining for return to its base. There are other characteristics to be desired, such as in an instance when the plane will engage another fighter in combat. In this case top speed, climb and maneuverability gain in importance. In present designs, maneuverability may lose importance, particularly the twin-engine type designed to carry larger loads at high speed with a protective rear gunner to balance loss of maneuverability.

Recent progressive developments in power plants have given the designer a new and quite lucrative field with the

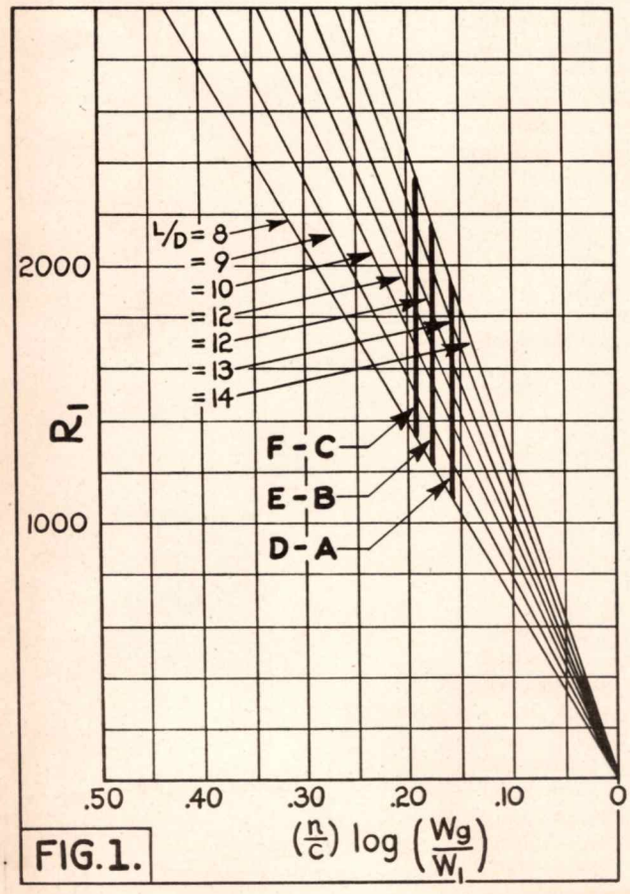


FIG. 1.

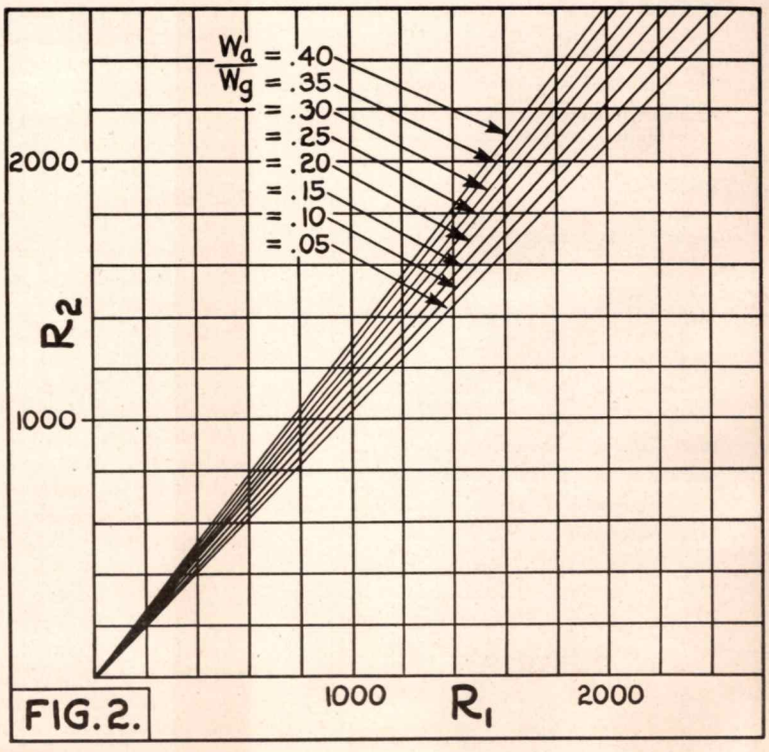


FIG. 2.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

TABLE I

Design	A	B	C	D	E	F
Gross wt. (lbs)	6,000	8,000	10,000	12,000	16,000	20,000
Horsepower	1,200	1,600	2,000	2,400	3,200	4,000
Av. sp. fuel con. (c)	.48	.42	.38	.48	.42	.38
Engines (no.)	1	1	1	2	2	2
Guns (no.)	8	8 2	8 2	10 2	5 2	8
Calibre	.30	.30 .50	.30 20mm	.30 20mm	20mm .50	20mm
Rounds (no.)	10,800	9,000 1,000	9,000 780	10,500 960	2,100 1,000	3,100
Rate fire (rds./min)	1,200	1,200 500	1,200 500	1,200 500	500 500	500
Amm. wt. (lbs)	720	600 300	600 600	700 740	1,620 300	2,400
Guns wt. (lbs)	192	192 104	192 238	240 238	596 104	952
Time st'dy fire (sec)	67	56 60	56 47	53 57	50 60	47
Fuel wt. (lbs)	1,080	1,440	1,800	2,160	2,880	3,600

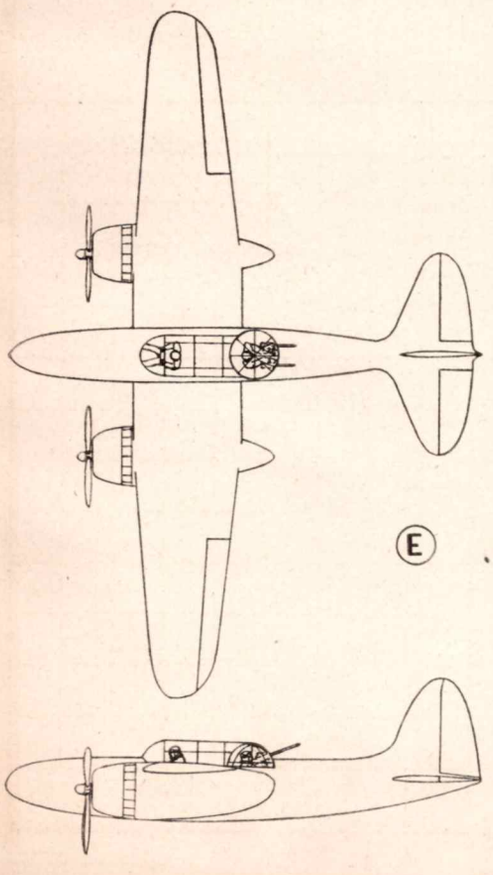
advent of 2000 hp engines. Because of this and other reasons there exists a trend in pursuit and fighter design towards craft larger than those conceived in the past. The twin-engine bomber and certain conceptions of the modern fighter are in many ways being merged, so there must eventually develop an airplane with much higher performance and better utility.

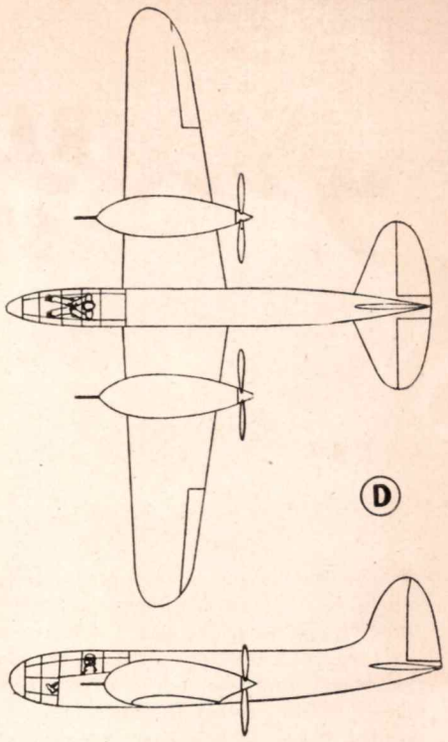
If such a design trend were made by terminating these two types, several advantageous gains could be made. If, for instance, a heavily armed twin-engined fighter could yield its guns and ammunition, except those needed only for protection, the weight saved could be replaced by bombs. It would be necessary that the airplane be equipped with gun mounts facilitating ready removal of the guns, ammunition boxes, chutes and any other items of appreciable weight. Bombs could be loaded in the vacant gun bays or removable bomb racks in the fuselage, and the gun mounts could possibly be designed for use as bomb racks. Since such a fighter would carry a number of guns and ammunition, it could displace this armament with a good bomb load. Good rear protection should be retained. A design of the proper all-around characteristics would simplify the production of the lower military aircraft bracket by producing one general type instead of several.

The range of such an airplane depends on several factors either directly or indirectly. Among these are aerodynamic cleanness, fuel consumption, efficiency of the engine-propeller combination and the amount of fuel load. The bomb load dropped will increase the range. However, assuming the same gross weight, an increase in bomb load will displace that amount in fuel which would decrease the range. In the fighter the load dropped would be the ammunition fired including cases ejected and dropped and belts disintegrated. All dropped loads are considered as being at a midway point or at the maximum radius.

A series of progressive preliminary designs are shown here with comparative data as given in figs. 1 and 2 and in Table I. Conceptions of the general arrangement and layout of the designs has been made principally with respect to the factors affecting range, although other items were also developed as a part of this material, rounding out a generally complete conception of each design.

The airplane is considered as flying out to its maximum radius to intercept an enemy aircraft, and having a highly effective fire power sufficient to completely disable the opposing machine with minimum duration of fire. Also the total duration of fire would be sufficient to enable the pilot to quickly attack as many machines as possible. The work here is made on the basis that when the maximum radius is reached the disposable armament load is dropped as a bomb. Actually, the rate of steady fire is approximately one minute. Then, during some time over this period, the power plant or plants will be operating at full rated output without traversing any of the range distance. This will to some extent decrease the range. However, since the purpose of such a design

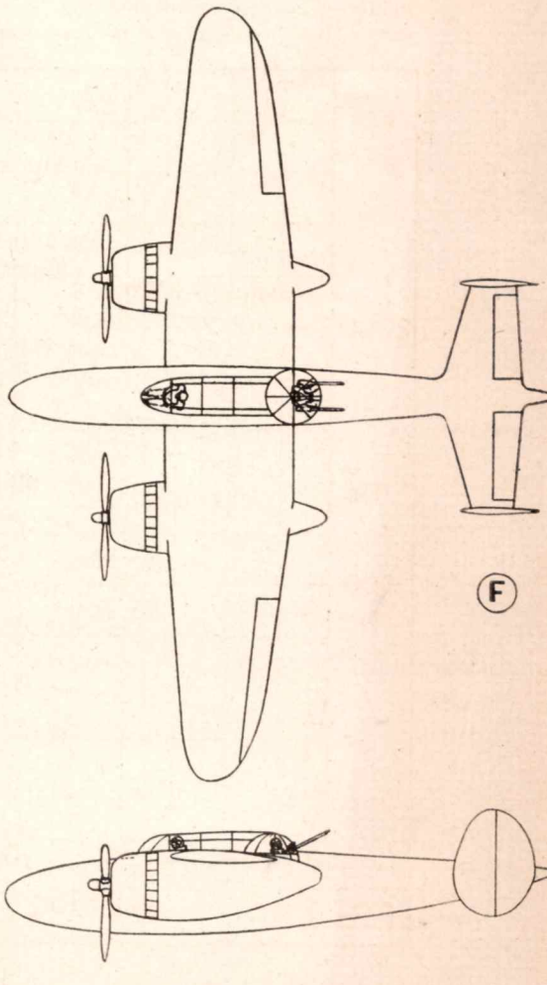




is to strike quickly and effectively at a number of aircraft, this period of time will be held to a minimum.

The series of designs here are made to give some view of the items affecting the subject. Six airplanes are considered employing power plants of 1200, 1600 and 2000 hp. The value of range for these airplanes will be much the same when the dependent design factors are consistent as they are here, with the ex-

(Continued on page 126)



See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

Guest Editorial

TRICYCLE LANDING GEARS

LAWRENCE BELL

IN the light of present military experience, the "rediscovery" of the tricycle landing gear several years ago marked an important development in aviation. I say rediscovery because the tricycle landing gear was no new development, having been first used effectively in 1909 and for years was incorporated in the design of many of the early airplanes.

Since the tricycle landing gear has returned to favor, it has been successfully demonstrated as an outstanding safety device on various types of planes ranging from heavy multi-engined bombers, down to the light planes and in single- as well as twin-engined fighters. It is unquestionable that this type of landing gear has saved many lives.

During a war, especially, aircraft are required to operate under conditions differing greatly from those provided by commercial and military super-airdromes. They must be able to take off from improvised fields, perhaps even highways. They must be able to disregard cross winds, when necessary, and to operate at night from unlighted areas.

Fully as important a consideration as the condition of the operating bases is the fact that military pilots, fatigued from the strain of combat and extensive patrols require as much relief as possible from the responsibilities presented by conventional landing gear. The British are an unimpeachable authority for the statement that many of their combat planes returning from long hours in the air have come to grief on their home airdromes as the exhausted pilots attempted to effect landings. This was in furtherance of the urgent request to rush tricycle landing gear to England as fast as possible.

Under certain circumstances any conventional airplane has a tendency to try to turn over during landing, for the reason that there's nothing out in front of the center of gravity to counteract this effort. But it is reasonable that if a wheel, placed forward of the conventional landing gear will stop this action, it should be incorporated into aircraft design. More than 12,000 hours have been logged in Airacobras during the past year, and their landing, takeoff and ground handling characteristics (inherent in tricycle gear) have been referred to enthusiastically by every pilot who has flown them; this statement includes the scores of British pilots who have been introduced to this cannon-carrying fighter.

Another benefit to be gained from the use of the tricycle gear is that it eliminates many of the precise requirements demanded in landing a conventional craft. With the conventional gear, it is desirable to lose flying speed, altitude and distance at exactly the moment a three-point landing is to be made. These conditions do not apply to the tricycle gear. Planes so equipped have been flown to the ground at any landing speed ranging from normal up to speeds 50% greater.

Experience has shown that in tight quarters the tricycle-equipped plane can be landed with brakes locked, with no fear of noseover. In such a short landing, or on a long run, or with downwind or sidewind, the tricycle airplane shows no tendency to ground loop. Not only that, but the non-ground looping char-

acteristic, inherent to the design, is the natural result of the tricycle landing gear design rather than to pilot skill.

I am not theorizing about the safety of tricycle gear, or referring merely to testing under ideal conditions. During the Army maneuvers in the South this Fall, Airacobras were flown a total of more than 3500 hours, during which they were operated from landing areas no better than might be expected during actual warfare, and were given the sort of punishment which would be expected during combat conditions by pilots with as little as 50 hours of experience in tactical operations.

Among the modern American Army combat airplanes equipped with tricycle landing gear are the following: The Douglas A-20-A light bomber and attack plane; Martin B-26 and North American B-25 medium bombers; Consolidated B-24 and Douglas B-19 4-engine bombers; and the Lockheed twin-engine P-38 pursuit, and the Bell P-39 Airacobra. However, this in no way reflects on the famous Boeing B-17 Flying Fortress, the Curtiss Hawk P-40 series, the North American Apache, and the Republic P-43 Lancer, all equipped with conventional landing gear. The Navy recognizes the safety and ground operation advantages to be had from the employment of three wheels. Landings have been made on a carrier with a tricycle landing gear airplane and the success of these tests has caused options to be placed in present contracts for carrier equipment to be changed over to the three-wheeled types.

In multi-motored aircraft no great problem is presented to the designers and builders for incorporation of tricycle landing gear. The greatest difficulty lies with single-engine fighters. The Spitfires, Hurricanes and Messerschmitts, with engines, accessories and armament occupying most of the space forward would have difficulty incorporating tricycle landing gear at this late day. Remove the engine to a point behind the pilot and the problem is simplified.

The problem in our own instance was solved by the combined efforts of Bell Aircraft and Allison engineers in placing the engine 10 feet away from the propeller. This not only provided the necessary space for the retracted nose wheel, but also enabled the airplane to carry a cannon and machine guns firing on the center line, and place the pilot in a position where he has vision unprecedented in a single-engine fighter.

Use of the retractable tricycle type landing gear has provided the following advantages: the ground looping hazard is eliminated; the airplane will not nose over when full brakes are applied at any speed; landing and takeoff technique is simplified; safety is increased when operated by pilots of limited experience; operation is improved for landing and taking off on small improvised fields; taxiing and parking are simplified; and fueling, maintenance and ground handling are facilitated since the airplane is always in a practically level position on the ground.

In the development of the tricycle landing gear, Bell Aircraft built a landing gear test vehicle so that engineers could study the action of the nose wheel under all conditions to which the airplane might be subjected. This test vehicle was built to the weight, balance and the tread and wheel base dimensions of the actual airplane and it was tested on the ground at speeds up to 70 mph. These exhaustive tests included runs over many types of fields, including concrete, loose cinders, grass and soft rough sod. In addition, runways and obstacles representing rocks and ruts were placed in the path of the wheel to determine the strength and stability of the front wheel under the conditions in which an airplane might be required to operate in time of war.

About the Author

Lawrence D. Bell had 23 years of experience as an aircraft executive when he organized his own company in 1935. In 1912 he was shop foreman for Glenn L. Martin in Los Angeles, served the company 16 years becoming vice-president and general manager. In 1928, he became associated with Consolidated Aircraft in Buffalo, first as general sales manager, later as vice-president and general manager. When Consolidated decided to move to San Diego, Bell decided to go in business for himself and together with Ray Whitman and Robert Wood he formed Bell Aircraft Corp. Initial work was making wings for Consolidated PBYs. Meanwhile, Bell's designers were working on the twin-engine multi-seat Airacuda fighter mounting two 37 mm cannon. Completed in the summer of 1937, this plane was hardly in the air before Bell ordered a single-engine, single-seat interceptor pursuit plane which incorporated superior fire power, tricycle landing gear for safety and visibility and extreme maneuverability. The result was the Airacobra, with its 37 mm cannon in the nose, Allison engine installed behind the pilot and 10-ft drive shaft.

Newspaper and magazine reports from coast-to-coast last month headlined stories relating to the Northrop Flying Wing, based on Aero Digest's publication of the Patent Office drawing below. The following article, released by Aero Digest to the newspapers, presenting first details and photographs of this development, formed the basis for subsequent news articles on the topic

NORTHROP'S FLYING WING

● The goal of American aeronautical engineers is in sight.

Long have they sought a flying wing; an aircraft whose every portion contributes directly to the lifting power of the airfoil, and now after a year of flight testing reports indicate that the results have been achieved in a radically different type of aircraft.

This new and unconventional type airplane has been undergoing extensive flight tests on the Mojave Desert near Los Angeles for the past year. Considerably increasing the efficiency of military as well as commercial aircraft, it was designed and constructed by Northrop Aircraft, Inc., of Hawthorne, Calif. Representing the first successful true flying wing, it has no tail surfaces or fuselage. Power plant and personnel are housed within the contours of the airfoil and there are no portions of the airplane which do not contribute directly to the lift of the airfoil excepting the small propeller drive shaft housings which extend above the wing.

Many types of tailless aircraft have been constructed and flown in the past. However, all of these incorporated a fuselage for housing the power plant and personnel, as well as auxiliary control surfaces of some type which were not an integral part of the wing and did not contribute to the useful lift of the supporting surfaces. Lippisch in Germany and Hill in England, among others, built aircraft of this type, but in each case considerable parasite drag was created by the fuselage and control surfaces so that the resultant craft did not take full advantage of the flying wing principle. In the Northrop design there is no fuselage, and adequate controllability and stability about all three axes has been obtained through the shape of the wing rather than through the use of external fins, rudders, stabilizers or other auxiliary surfaces.

The basic conception of a flying wing in which all functions of the airplane are combined in one large airfoil is almost as old as the art of flying. It has been the subject of scores of articles by inventors and designers who have shown interest in the subject for the past 20 years. It is generally recognized as being the ultimate possible refinement based on the present concept of the flying machine, as there is no method by which improvement in performance can be secured except through the elimination of unnecessary drag or the increase of horsepower in the power plants used. There have been many difficulties attendant upon this development, however, as demonstrated by the fact that although the flying wing has been universally recognized for years as an ultimately desirable objective, little actual progress has heretofore been made in its development. The Northrop organization, however, has solved these problems and has proved the practicability of their solution by several hundred flights in which all questions of stability, controllability and maneuverability have been answered.

Previous concepts of the flying wing have envisioned a craft having huge proportions in order that all of the contents of the conventional fuselage could be satisfactorily housed within the wing. The Northrop design, however, renders the flying wing concept practical in planes having an extremely small span and yet has ample room within the wing for the pilot and two 120 hp Air-cooled horizontally-apposed engines. The Northrop wing, if applied to a passenger transport of conventional size, such as is now used by the majority of airlines, would have a thickness ample for the present cabin and comfortable housing of passengers, crew and cargo. If applied to an airplane of the size of the four-engined Douglas B-19, the wing thickness would be between 15 and 20 ft. Such dimensions provide considerably more space for housing cargo or passengers than has been ob-

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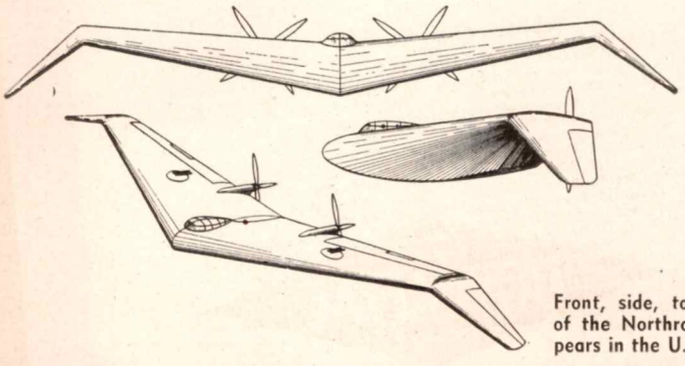

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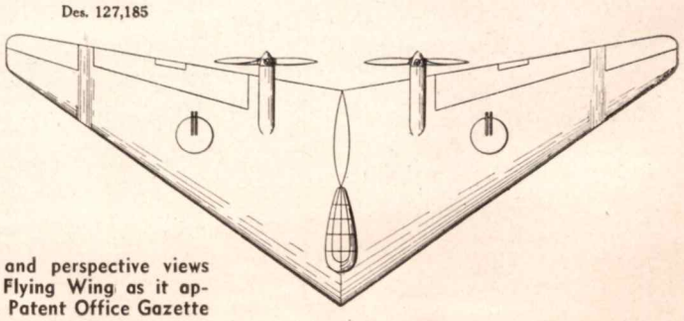


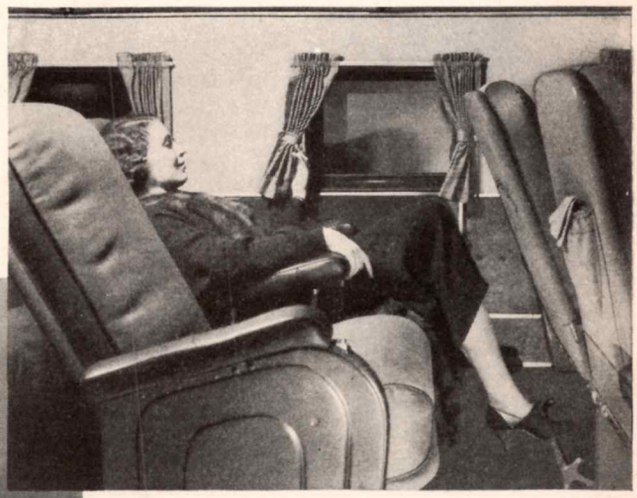
Front, side, top and perspective views of the Northrop Flying Wing as it appears in the U. S. Patent Office Gazette

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

DOWMETAL MAGNESIUM

DOUGLAS SAVES WEIGHT WITH FABRICATED DOWMETAL

Douglas DC-3 transport in flight.



Reclining passenger seat of Douglas DC-3 with side panels fabricated of DOWMETAL sheet. Several castings are also of DOWMETAL.

Douglas pilot seat for DC-3 fabricated from DOWMETAL sheet, extrusions and castings.

The pictures of some of the parts used by Douglas Aircraft in their DC-3 transport were chosen primarily to illustrate the fabrication of DOWMETAL* magnesium sheet.

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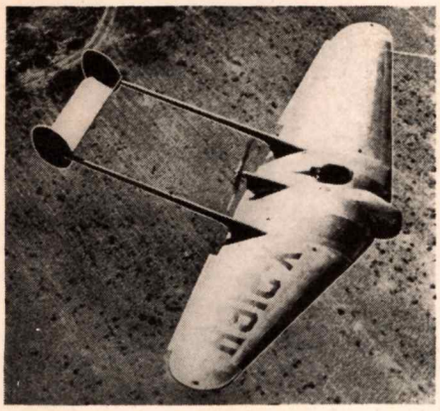

Northrop's "flying wing" of 1929

(Continued from preceding page)

tained in the past through the use of conventional designs, and the practical application of the scheme is possible for the near future and need not be delayed until airplanes of the size of the B-19 are in more common use.

Engineering the Northrop Flying Mockup was begun in July 1939, for the primary purpose of investigating the flight characteristics of such a design, and the aircraft was first flight-tested by Vance Breese at the Muroc Lake Army Base exactly a year later. Commencing with short hops at an altitude of only a few feet and a length of about a mile and progressing to the present long-range flight capabilities, the craft has been flown on more than 200 different occasions, utilizing numerous modifications of airfoil and control surface arrangements to determine the best combination.

Maneuverable and Controllable

In its present form, aircraft is just as stable, controllable and maneuverable as any conventional airplane of its capacity. Its response to the controls and its feel in the air are normal and are identical to those obtained through the use of conventional control surfaces on a conventional airplane. Although the first flights were conducted by a testing specialist, he soon turned the aircraft over to other pilots, saying that there was nothing unusual in its flight characteristics and that it could be flown by anyone having ordinary piloting ability.

The airplane employs two engines buried in the wing on either side of the pilot's cockpit, driving pusher propellers through extension shafts approximately 10 ft long. The airplane also could be built as a single engine pusher or tractor.

pusher installation is also of value in that in eliminating the effect of the slipstream over the wing, it reduces the drag of the airplane. There is also less noise in the crew and passenger compartments than would be possible with a tractor installation.

While advantages of the Northrop design are apparent, they may be summarized as follows: Comparing airplanes of the same approximate size and carrying capacity, the Northrop design has from 33% to 50% less total drag than a conventional airplane. This means that the same speed can be obtained with approximately half the horsepower, or that the speed may be increased 25% to 30% over that of the conventional design of the same horsepower. The impetus which can be given to air transportation by such an improvement cannot be predicted, but it is safe to say that the usefulness and economic value of aircraft might be doubled or trebled by such an improvement. The savings in cost of construction of such an airplane as compared with conventional types is also extensive, as the Northrop aircraft consists essentially of a thick wing in which there are virtually few structural complications, and in which there is ample room for the installation of the many auxiliary component parts which make up the modern airplane. Most modern aircraft wings are relatively thin so that additional structural weight must be added to provide the necessary strength and rigidity. The Northrop design embodies considerably deeper wing sections than are conventional, and therefore automatically permits appreciable savings in structural weight.

Anyone who appreciates the complexity of electrical, hydraulic, power plant and landing gear installations in the modern airplane will also readily understand the saving in time and weight which can be effected through the close coupling of all operating units within the wing, and the large amount of space available within which such installations can be made. Even without the aerodynamic advantages inherent in the all-wing design, the structural simplicity and added space for cargo, passengers and various necessary components would more than justify the adaptation of the design to modern transport aircraft.

Twenty Years of Interest

The Northrop wing is the result of almost 20 years of interest and study of the project on the part of John K. Northrop, president of Northrop Aircraft. In 1929 he supervised the design and construction of a so-called flying wing, but at that time did not undertake to build a tailless ship, and while his airplane at that time provided space within the wing for crew and power plant, tail surfaces were carried on two outriggers which extended to the rear of the wing. In the interim between 1930 and 1939 Mr. Northrop's interest continued, and with the formation of Northrop Aircraft, Inc., in 1939 the opportunity again arose to continue his experiments.

Jack Northrop is the designer of such famous aircraft as the Lockheed *Vega* which had the first monocoque type of fuselage; the *Alpha, Gamma* and *Delta* series of aircraft, and the A-17 attack plane. He spent nearly all of 1937 studying his plans and basic theory for an aircraft in which the lift/drag ratio reached 100, and of his latest design he says, "I hope this craft will be a major contribution to aeronautics, both in performance and in simplification of structure. The principle it embodies, I hope, will cut the normal drag coefficient in half."

With the help of the design staff of the new company, many of whom have been with Mr. Northrop since the "flying

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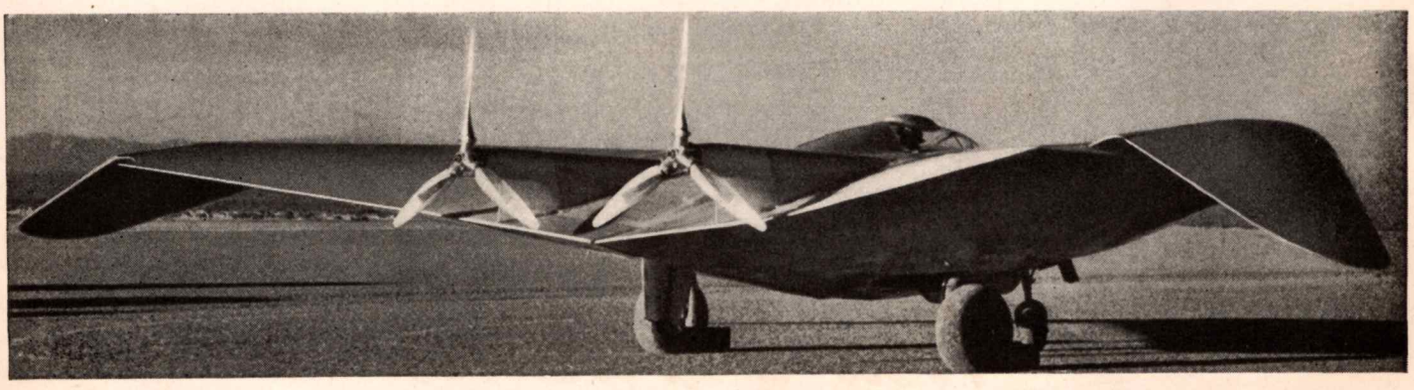
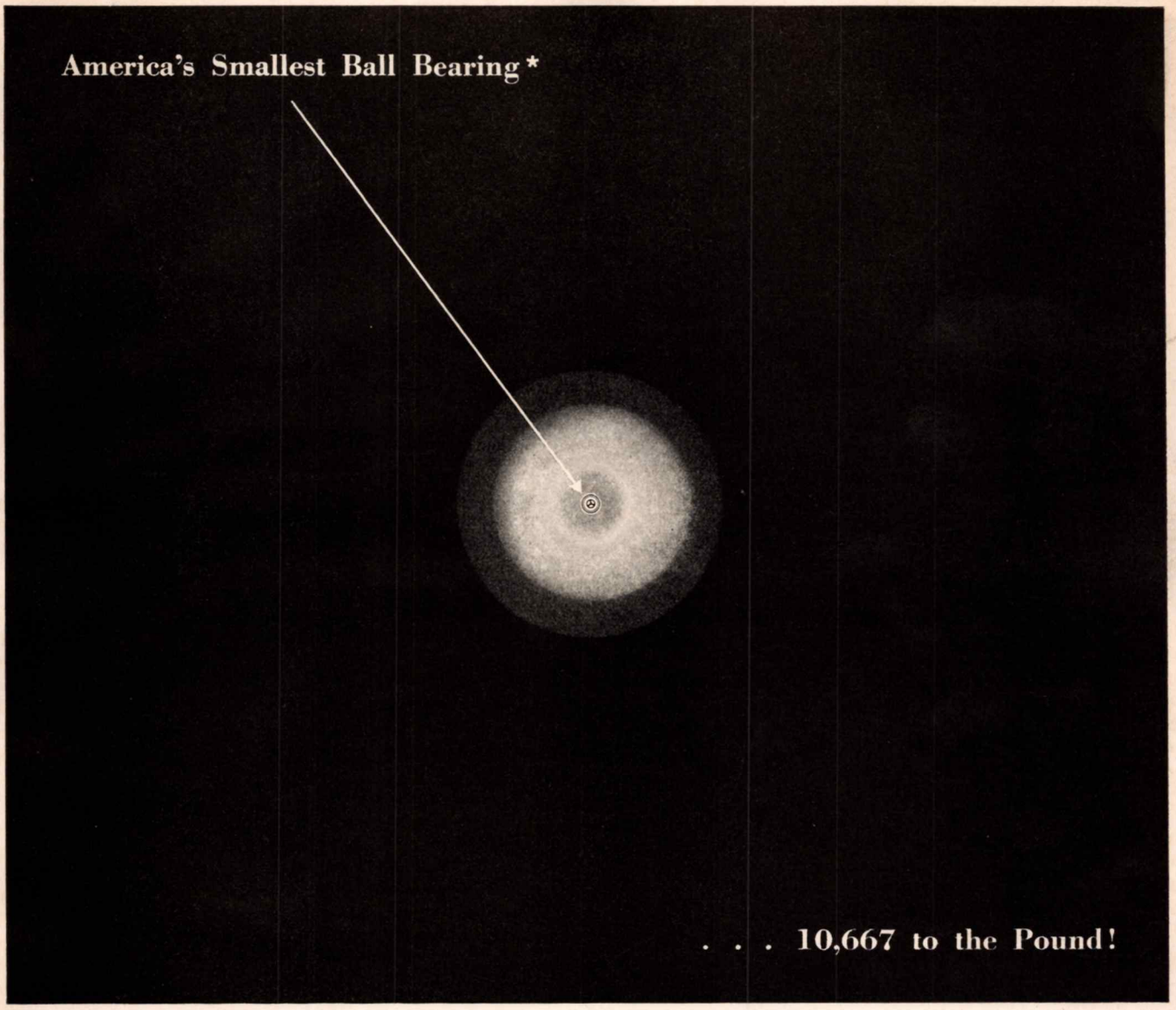


Three-quarter rear view of the twin-engined Northrop Flying Wing which has been undergoing extensive flight tests in California

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



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3039

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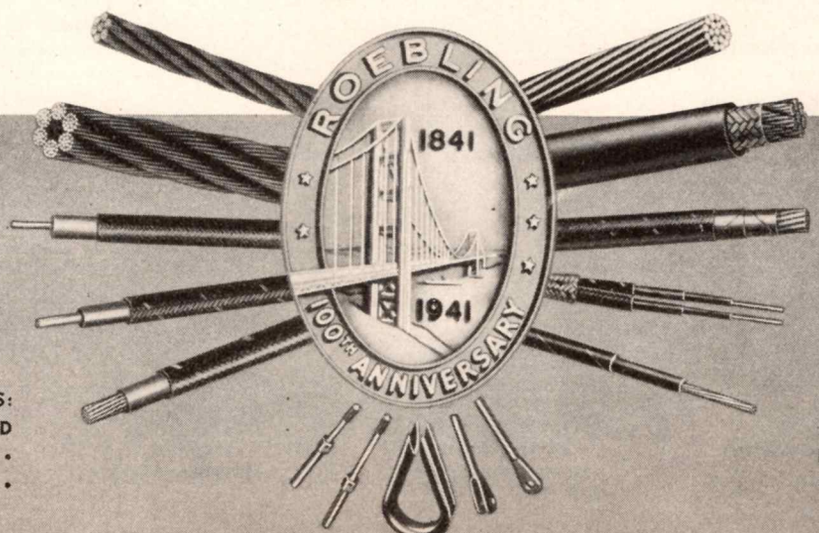

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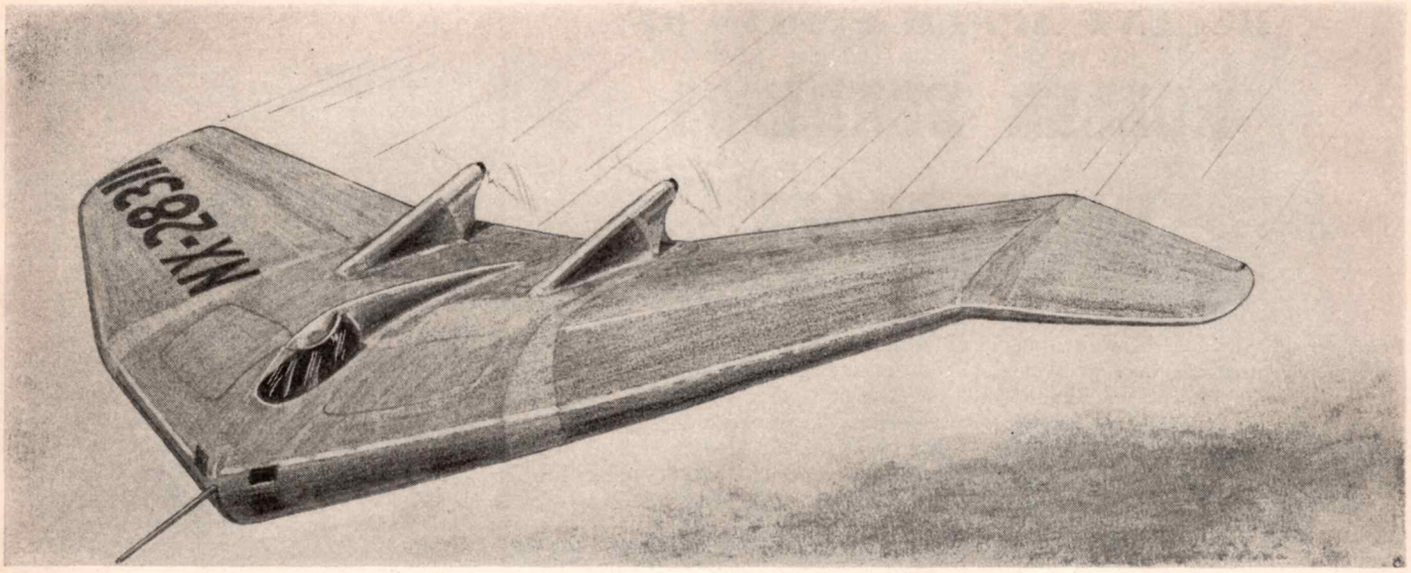


Artist's sketch of the Northrop Flying Wing in flight, as seen from above, showing wide visibility from pilot's compartment

(Continued from preceding page)

wing" of 1929, the new project was started. At the early stage of development, the problems of design were discussed with Dr. Theodore von Karman, Director of the Daniel Guggenheim School of Aeronautics at California Institute of Technology, and Dr. William R. Sears, who was then von Karman's assistant, but who now is Chief Aerodynamicist for Northrop Aircraft.

Encouragement given the project by these men, and their assistance in working out the aerodynamic problems involved have proven invaluable and were of major importance in the satisfactory development of the design. Other persons who contributed to the present accomplishment are Moye Stephens, Secretary of Northrop Aircraft, and whose interest in the project has led him to do a substantial portion of the testing to date; and W. J. Cerny, Assistant Chief of Design for Northrop Aircraft, who has had the project under his supervision since its inception. The Army Air Corps also took an active interest in the project as a part of their research program. It collaborated in the investigation of wind tunnel models at Caltech and in the Northrop wind tunnel, as well as free flight model tests at the NACA laboratories at Langley Field.

Novel Wing Tip

The airplane employs a novel configuration of the wing tip, which is drooped downward in a direction opposite to the normal dihedral of a conventional wing as shown in the drawing for design patent. This wing tip takes the place of the conventional vertical control surface and its use makes it possible to obtain almost any desired combination of lateral and directional stability without loss of lift. This design also has been applied experimentally to conventional aircraft by the Air Corps with promising results, and may be used to advantage in certain cases where tip stalling characteristics are bad, or where insufficient directional stability is obtained through the use of conventional tail surfaces.

Provisions for Adjustments

The airplane under test has provisions for adjustment of wing sweepback, dihedral and twist, as well as for variable tip configurations and center of gravity locations. It has also been flown with a number of different types of control surfaces and surface control mechanisms. In general, it may be said that longitudinal and lateral control are obtained, as in other tailless airplanes, by "elevons" (combined elevators and ailerons) located along the trailing edge of the wing; these are moved together for longitudinal control, and in opposite directions for lateral control. A number of different schemes have been tried for rudder control, several of which have given satisfactory results. However, rudder modifications are still being tested and the final arrangement may be considerably different from that shown in the accompanying photographs. The wing has such configuration as to provide satisfactory static and dynamic stability about all three flight axes. Actually, as originally flown, the aircraft proved to be entirely too stable in certain respects, and modifications had to be made to reduce rather than to increase stability. The airplane was first flown with two 65 hp, 4-cylinder Lycoming engines, and these were later changed to the 120 hp, 6-cylinder Air-cooled (Franklin) engines now installed. The latter engines were installed to obtain flight characteristics at higher speeds than were possible with the original engine installation. Ample air for circulation about the cylinders is obtained through ducts which extend from the leading to the trailing edge of the wing.

In the past designers of tailless aircraft encountered difficulty in the application of landing flaps. It is known that several high lift devices for application to the Northrop wing are under construction or have been flight-tested on the airplane. However, no information is available as to what type has proved most satisfactory. In fact, details of performance are not at present available and probably will not be released for some time, but it may be prophesied that substantial increases in range, speed and economy in production and operation may readily be obtained in the near future.

Larger Designs Studied

The work accomplished to date has enabled the Northrop organization to undertake preliminary studies of several larger designs utilizing the flying wing principle, and it is expected that aircraft of this type will be in active operation within the next few years.

In view of the work accomplished to date, it is Mr. Northrop's prediction that transport aircraft having cruising speeds approximately 100 mph greater than the best now obtainable can be built as soon as the necessary engineering can be completed and construction facilities made available. Obviously, the full engineering and construction facilities of most aircraft companies are now engaged on military projects, which may make it impossible to apply the Northrop wing to commercial transport in the immediate future. However, considerable valuable information is being obtained during the continuing flight test program.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

RECENT APPLICATIONS OF

ROLLER BEARINGS IN AIRCRAFT

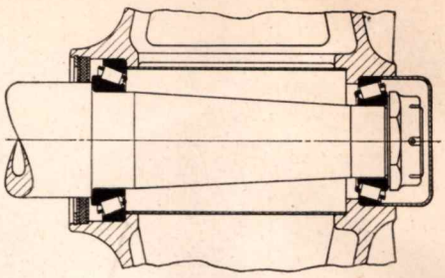


Figure 1

● In general, aircraft bearing applications require that the maximum of capacity be built into the minimum of space in order to conserve weight. However, bearings are expected to, and must operate with a minimum of attention. The engineer is, therefore, faced with the problem of selecting bearings and designing mountings that will give satisfactory service and which, at the same time, will not be excessively heavy or bulky. Such designs are not created overnight, but are the result of extensive and careful study and testing. Such work has been carried on since the beginning of the industry by both the aircraft engineers and the bearing engineers, and the present designs are the result. This work is continuing at an accelerated pace and it is probable that the next few years will see numerous changes and improvements in aircraft bearing mountings.

The first point at which Timken roller bearings were extensively applied in aircraft was in the landing and tail wheels. The inherent ability of the tapered roller bearing to carry thrust and radial loads in any combination is particularly valuable in these wheel applications. The design commonly used is familiar to most engineers and a typical wheel mounting is shown in fig. 1. The bearings are adjusted by the castellated nut so that excessive end play and consequent loose wheels are eliminated.

The next point at which Timken roller bearings were widely used was in the rocker arms of radial engines. Present design of rocker arm bearing mountings, shown in fig. 2, is the result of many years of development and testing by both the engine manufacturers and The Timken Roller Bearing Co. Again, the combination of radial load from the valve action and thrust load from the angularity of the push rod is successfully handled by the tapered roller bearing. The bearing consists of a double inner race and two single outer races spread apart by a horseshoe spacer fitted at the factory to give the proper internal operating clearance in the bearing. One of the outer races is made with a flange to locate the assembly in the rocker arm and the unit is so assembled that the thrust load is transmitted to the bearing through this flange. The bearing is press fitted in the rocker arm and loose fitted on the pin. Lubrication is obtained from the same oil that is circulated to the other points in the engine.

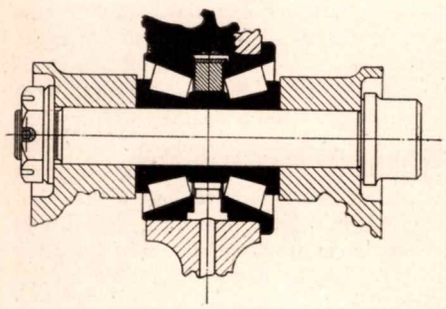


Figure 2

While wheels and rocker arms have been equipped with Timken roller bearings for a comparatively long period of time, a more recent use incorporating these bearings is the Dynafocal suspension for radial engines, developed by Wright Aeronautical Corp. and Lord Manufacturing Co. The particular type of design of Dynafocal suspension which uses Timken bearings is the link type, and this assembly is now used on practically all installations of the Wright *Cyclone* 9- and 14-cylinder engines.

While a complete discussion of the principle of Dynafocal suspension is beyond the scope of this article, the main features may be described as a flexible mounting system, which, through controlled directional spring restraint, gives a true center of gravity support for the assembly; and through its use the equivalent effect is obtained of mountings spaced symmetrically in all directions about the center of gravity even though the mountings are actually positioned toward the rear of the engine. The advantage gained by employing this type of suspension is that a soft enough support can be used to provide isolation for all types of vibratory disturbances arising from the engine propeller combination without undue loss of stability for the suspended assembly under load conditions imposed by maneuvers and landing of the airplane.

The assembly as used on a *Cyclone* 14-cylinder 2-row engine is shown in

(Continued on following page)

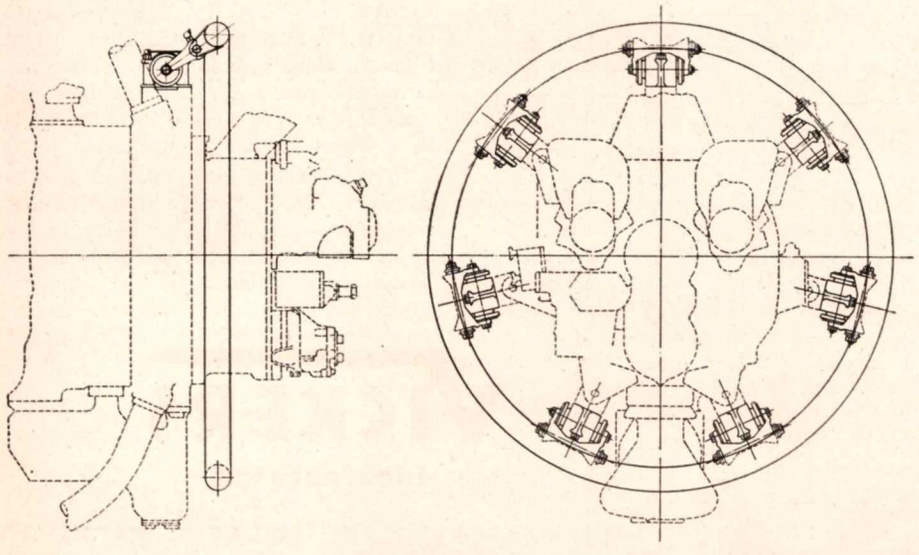


Figure 3

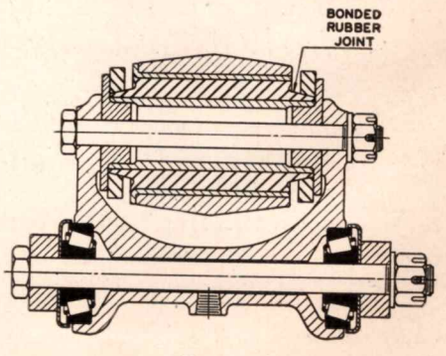
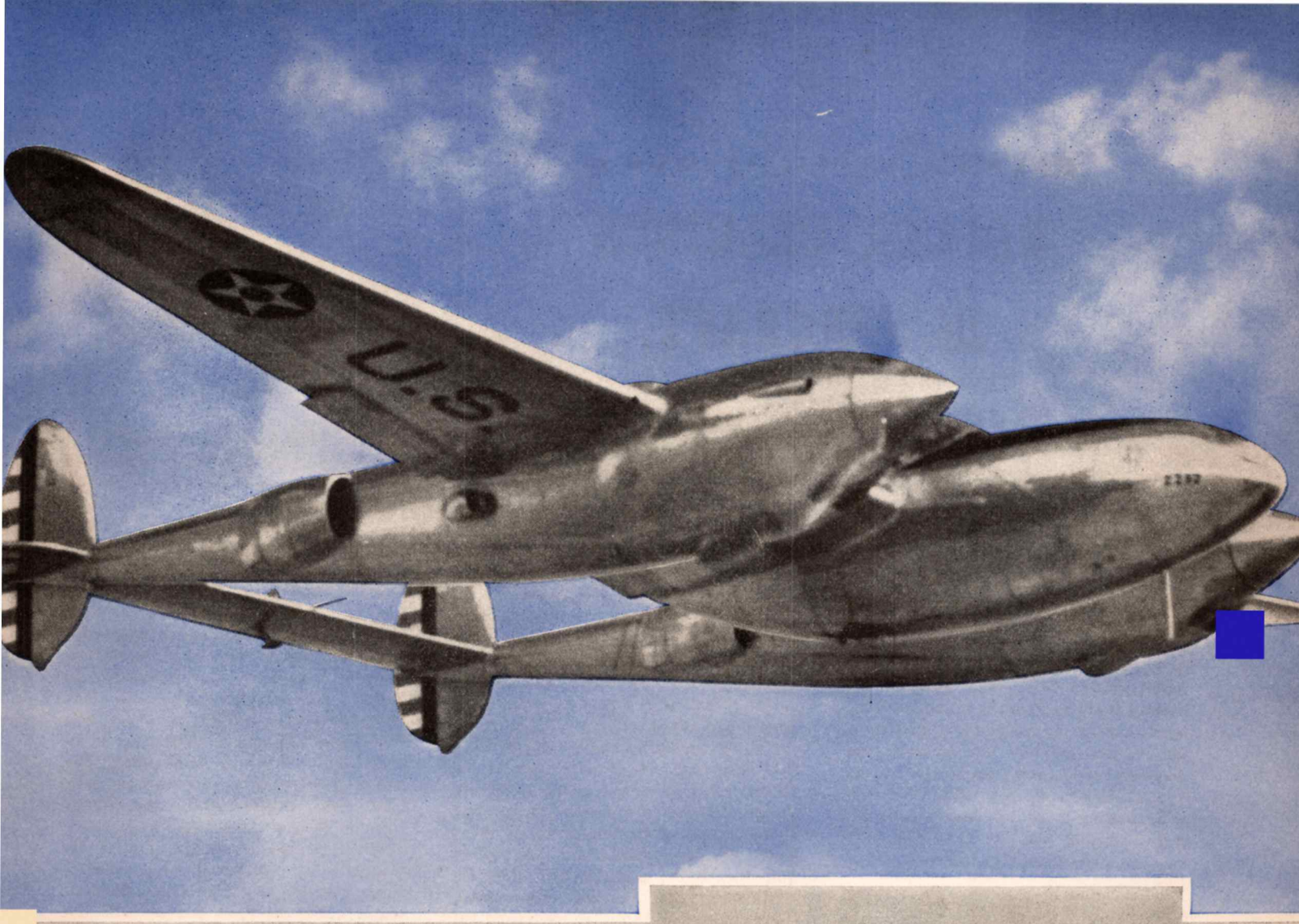


Figure 4

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



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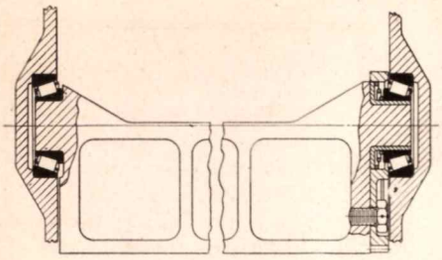

Figure 5

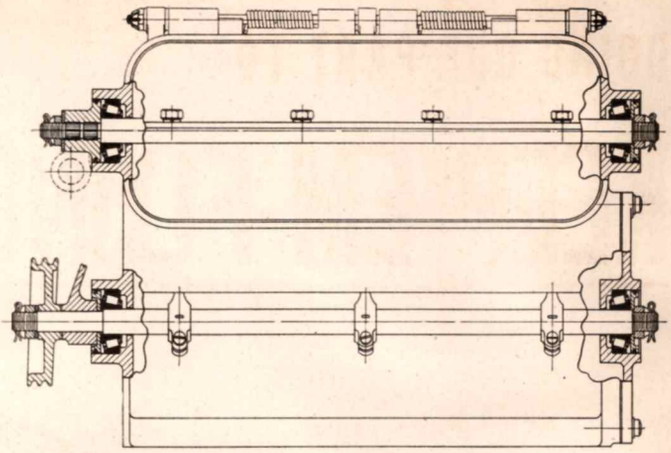

Figure 6

(Continued from preceding page)

fig. 3, reference to which will indicate how the Dynafocal suspension functions and the part that the Timken bearing plays. Attachment of the mounting is shown between the rear end of the engine and the engine mounting ring, which is made part of the airplane engine mount structure. Connection is made through the use of 7 links spaced symmetrically about the engine mounting ring. One pivot point for each link is a Lord tube form shear type mounting and the other pivot point is accomplished by Timken bearings, which are pressed into the link forgings. The mountings are soft in the axial direction, soft torsionally and comparatively stiff radially. This means that the link assembly is stiff along the links, but is free to swing about the bearing.

The links are placed at a predetermined angle so that they point to a common focal point ahead of the center of gravity of the suspended assembly. The overhung load is carried along the link insofar as the top mountings in the suspension are concerned, and as the mountings approach the horizontal axis of the engine the weight is carried axially by the mountings. The net result of the link action is that the suspension is fairly soft in rotation about the horizontal and vertical axes of the engine and rotative movement occurs about the center of gravity, through a correct choice of the mounting stiffness and the angle at which the links are placed. Likewise, movement along either the horizontal or vertical axes tends to occur in a straight line for the center of mass, and adequate softness is allowed for this type of movement also. Insofar as rotative movement about the thrust axis is concerned, here the links are inactive, but the axial softness of the mounting proper gives the necessary freedom for this mode.

The function of the roller bearing is to provide all the freedom possible for the links to swing and at the same time to take the radial and thrust loads on the bearings. Radial loads on the bearings are caused by the weight of the engine plus the thrust from the propeller. Thrust loads on the bearings largely come from the propeller torque reaction. The axial movement of the bearings is slight, being oscillatory rather than rotational, but in spite of the condition which ordinarily might lead to brinelling of the races, the service life of the bearings has proven to be quite satisfactory.

The mounting of the bearings in the link itself is shown in fig. 4. This is an indirect mounting with an adjustment obtained by shimming between the bearing cone and the member which backs it up. The entire assembly is locked by the nut and cotter pin shown and grease lubrication is provided.

Another recent and interesting application of Timken roller bearings in aircraft is on the throttles of the Holley carburetor (fig. 5). These throttles are made in the form of modified cylindrical sectors having the discharge nozzle located between them and forming a streamline venturi-shaped passage for all degrees of opening. The throttles fit in the main body with a small end clearance and are sealed against leakage by a brush which bears lightly on the top of the cylindrical surface. A gear on each throttle and on the throttle lever shaft serves to drive them in synchronism.

In applying the bearings the bearing cones are mounted on the throttle itself and the cups in the main housing. Since the loads are quite light and the throttle does not make a complete revolution, it is permissable to use a spring butting against the cone at the left hand bearing to maintain the bearing adjustment. The cone is mounted on a steel sleeve which is pressed onto the throttle. Bearings for this application are chrome plated to resist corrosion.

The application of Timken bearings to the butterfly valves on the air scoop of a Stromberg carburetor is shown in fig. 6. On this scoop, developed by the Bendix Products Div., Bendix Aviation Corp., in collaboration with TWA, two butterfly valves are provided to control the cold air and hot air intake respectively. The shafts on which these butterflies are mounted are supported by roller bearings as shown in fig. 6. The two butterflies are so interlocked that the carburetor intake can vary from full cold air to full hot air with intermediate settings.

The bearing mounting is quite simple, the cups being pressed into the main housing of the air scoop while the cones are mounted on the butterfly shaft. Adjustment is obtained by the castellated nut locked with a cotter pin shown and simple felt closures are provided.

Acknowledgment is made of assistance in the preparation of this article given by the Lord Manufacturing Co., the Holley Carburetor Co., and the Bendix Aviation Corp.

FIGHTER STRIKING POWER

(Continued from page 113)

ception of certain variables among which is the specific fuel consumption which decreases with power. Range computations have been made by Breguet's derivation, which is a function of propeller efficiency (n), specific fuel consumption (c), L/D for the airplane and the ratio of gross weight to gross weight less fuel, (Wg/W_1).

In fig. 1 a part of this function is plotted against range values of the overall L/D. Values for this extent of the work for the design series are plotted through the range of L/D curves. Fig. 2 yields the final value by the effect of disposing load at the mid-range point. This is plotted for that obtained in fig. 1 against the ratio of the ammunition or bomb load to the gross weight. When the airplane is employed for bombing, the bomb load is the ammunition and armament weight removed.

The ratio of lift to drag is quite dependent on any results sought. Although this value can vary under conditions of a particular design, the range of L/D values given here are not necessarily to be construed as those only for the design series. However, the actual values of the design series will not be especially high, because of the higher operating speed. This can be taken as among the lower half of the set. Aerodynamic cleanness as in every other factor of airplane design is highly contributory to good range and such a design will meet that requisite. Striking power agrees with this in that a relatively high speed is desirable when the airplane reaches its objective. Armament of good fire power and effective range is to be desired when an attack is made at high speed with least amount of maneuvering.

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New Arc Welding Technique for Aircraft Tubing

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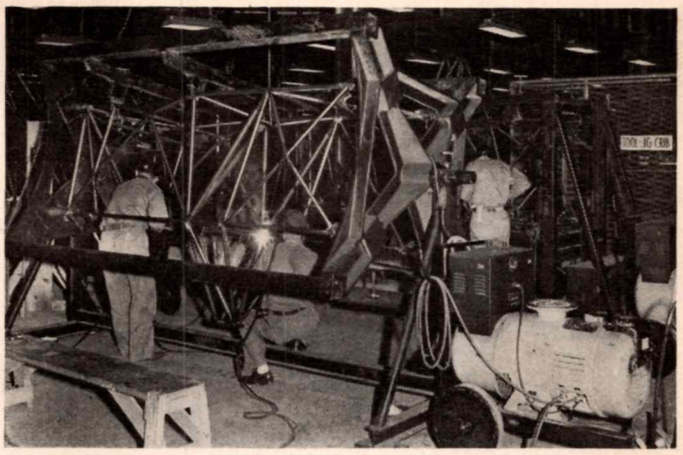


Welding tubular structures in major assembly jigs

● Fortified by long experience in producing aircraft, executives of North American Aviation, Inc., availed themselves of every production expediency when they were considering the design and layout of their new plant in Dallas. As a result, that plant is now endowed not only with the most modern developments in aircraft fabrication and assembly procedures, but it also incorporates many production short-cuts proved through intensive use. Although the following applies only to one phase of the work—the attention given to the problem of welding chrome molybdenum steel tube fuselages—it is nevertheless typical of the careful planning applied to all departments in efforts to achieve maximum production.

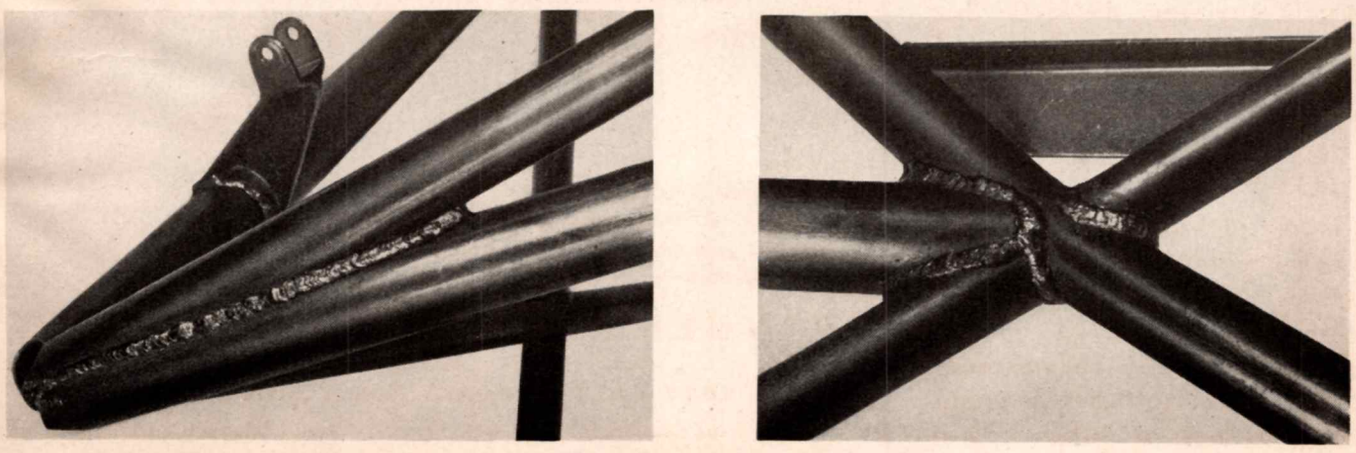
General Fuselage Construction Plan

A characteristic of tubular fuselage construction is the necessity for careful and precise preparation and fitting of the component parts. Use of the round tube section is dictated principally by its inherent high strength/weight ratio, while the choice of chrome-molybdenum steel permits further reduction in the weight of the structure. Aircraft designers always endeavor to take full advantage of weight reduction possibilities and even specify a careful preparation of all joints even though that preparation may be relatively expensive. Furthermore, the safety of the structure is considered to depend on the accuracy with which the fit-up matches the design. Actually, this is the only way in which the manufacturer can be sure that the load distribution in the structure is what the designer intended it to be.

Close-up view of the location of the crater eliminator control switch. This permits the operator to increase or decrease the resistance in the excitation field of the welding machine without interrupting the arc

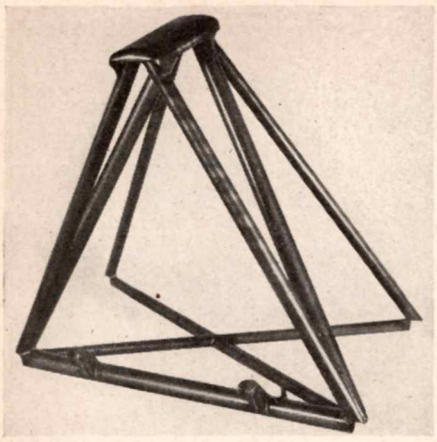
The complete fuselage construction is not a single unit operation. Fabrication is expedited by the separate welding of a number of small sub-assemblies which eventually are brought together in the main assembly jigs. These sub-assemblies therefore must be fabricated to extremely close dimension tolerances so that fit-up adjustments in the final assembly will be reduced to a minimum. Each individual tube is cut, milled if necessary, and the edges are ground. At this stage of construction. the part is not yet ready to go into stock. The tubular parts are first placed in dummy jigs which exactly match the actual assembly jigs. Here, the accuracy of the fit-up is carefully checked, and should there be a fault of dimension or fit-up, the unsatisfactory tube is returned for correction. Only when the dimensions and the fit are thoroughly verified do the tubes go into stock for use in the fuselage construction.

This dummy assembly procedure might appear to add several operations to the work program, but it has the virtue of assuring a practically perfect fit in the final assembly jig where time is most important and delays costly. Consequently, the welding crew can make consistent progress without stopping to correct errors in dimension or alignment.



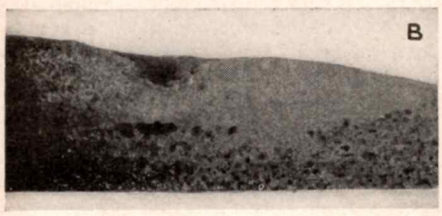
Welded cluster of tubes, and (at the right), a typical cluster of tubes of several different sizes

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



Completed sub-assembly of a "nose-over" pylon

Typical weld defects which are caused when craters are allowed to form at the end of a metallic arc weld deposit



Actually, the dummy fit-up procedure has not only increased but has greatly advanced the daily production of fuselages.

The welding method used in the fuselage assembly is the metallic arc process. Airco No. 90 electrodes ranging in diameters from 1/16" to 1/8" are employed with current settings from 40 amps for the 1/16" electrode up to 90 amps for the 1/8" size. Core material of the electrode is medium carbon steel which has been found most satisfactory for welding thin sections of the chrome molybdenum alloys because the weld metal itself absorbs a satisfactory amount of the alloy materials from the parent metal, and the carbon steel wire has more favorable welding characteristics than chrome molybdenum wire.

Electric Arc Craters

The welding technique employed is recognized as being generally satisfactory for the welding of thin sheet material. However, a considerable disadvantage has cropped up in the application of arc welding to thin walled tubing because of the formation of a crater at the end of a weld deposit. That is, the sudden breaking of the arc by conventional methods brings the flow of metal from the electrode to an abrupt stop, and, because there is not a large area of parent metal in a plastic condition when welding such thin stock, there remains after cooling a porous area slightly ahead of the spot in the parent metal where the arc was interrupted. Although these areas are small, they are highly objectionable because of the vibratory nature of the stresses to which the structure is subjected in service. Furthermore, when several tubes are brought together in a cluster at a single joint, the number of the craters (and therefore the extent of the porosity) is multiplied.

Arc craters formed in aircraft stock not only reduce the physical strength of the weld, but sometime cause progressive fracture in the parent material, since the fracture lines extend from the crater to the non-heat-affected parent metal. These irregular defects are in addition to the gas pockets that are usually formed at the center of the crater itself. Some welders believe that by depositing new weld metal over the crater they cause a remelting which fills the cavities and floats entrapped slag to the surface. However, such a defect in the first weld deposit cannot be corrected by working on it from the top in this manner. It would be better to recognize that arc craters cannot be satisfactorily repaired on thin gauge material because of the fact that porosity extends to the bottom of the parent metal. When craters do exist it would be better for the inspection department to require that they be removed by grinding rather than filled up and beautified by a second layer.

The "Stroco" Crater Eliminator

Several methods have been tried to overcome the objectionable crater formation so as to make arc welding more acceptable for aircraft tube assemblies. Use has been made of extremely heavy flux coatings on the electrodes, welding with extremely low currents so as to localize the heat effect, and of special techniques in application. The success of these devices has been varied. The fundamental cause of the trouble is the abrupt removal of the source of heat; that is, the breaking of the arc.

The procedure adopted by North American utilizes an auxiliary device called the *Stroco* Electric Arc Eliminator which is attached to each of the Wilson *Hornet* 200-amp motor generator arc welding sets used in the plant. This device does not abruptly break the arc, but causes it gradually to fade out under control. It introduces into the excitation field of the generator an automatically controlled variable resistance of large enough capacity to build up the resistance in this field so that the excitation is reduced gradually to an extremely low point, regardless of the current setting of the welding generator. The increased resistance in the excitation field, which is accompanied with practically no reduction of the arc voltage, causes

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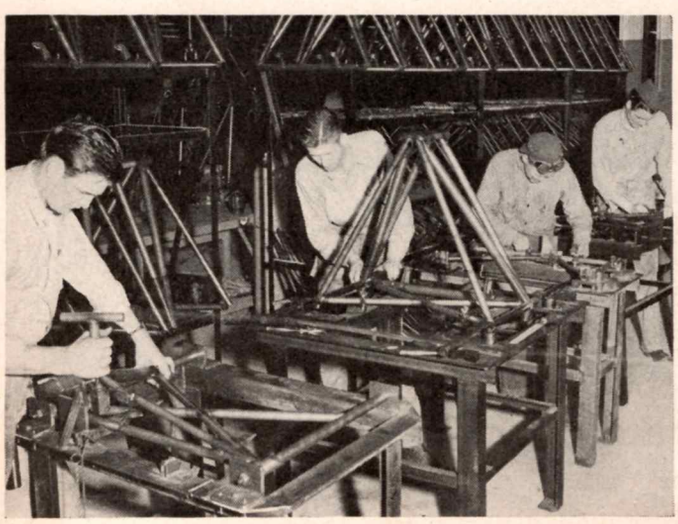

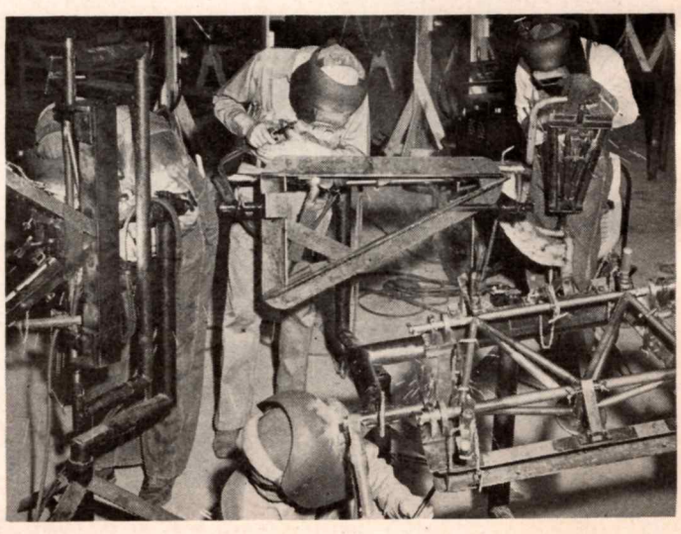

The sub-assembly welding department (left) and dummy assembly jigs (right)

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

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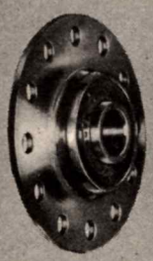

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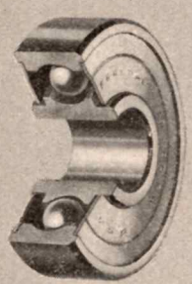

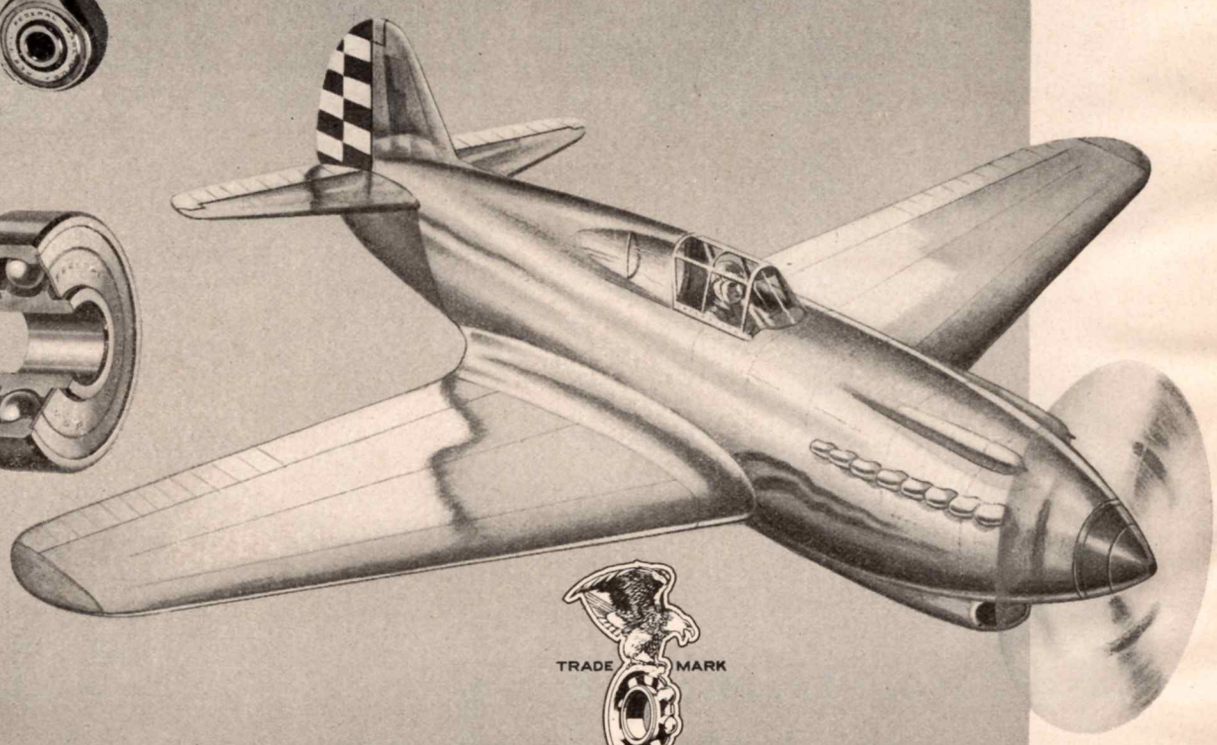

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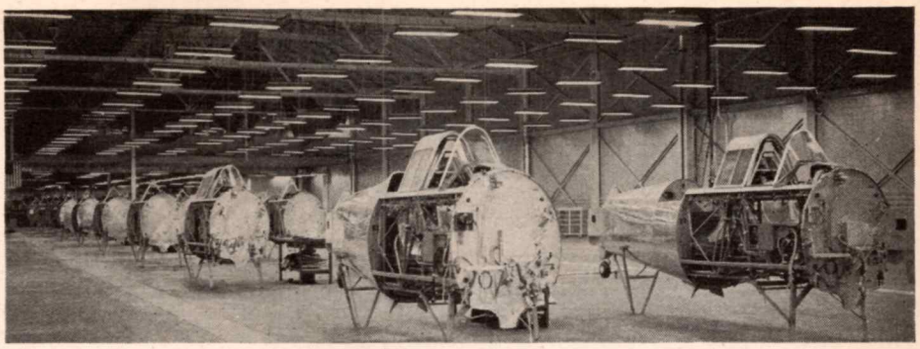
(Continued from preceding page)

a gradual but uniform falling off of the welding amperage until finally the heat generated between the electrode and the parent metal is no longer sufficient to cause the melting of the metal electrode.

Introduction of a welding technique which involves a shading variation of the welding current, during the deposition period and under the control of the operator, is a new departure in arc welding practice because the conventional arc weld is ordinarily considered to be controlled in quality by the consistency with which an even rate of heat is maintained throughout the deposition period. The majority of skilled welders in the Dallas area have been trained and have gained their experience principally on welding plate materials and other medium-heavy sections that are so widely used in oil field and refinery equipment. It is comparatively difficult for operators who have formed the welding habits exactly suitable for these latter materials to make the adjustments in their manipulative technique that are involved in working on thin material and with a new type of procedure. Also, under present conditions, there is no great lack of employment for operators who do not readily make such personal adjustments. It has therefore been found more satisfactory to build up a welding organization of young men who have had no previous welding training or experience but who have been specially trained from the beginning to weld aircraft tubing with the equipment and with the procedures that are used in the North American Aviation plant.

How the Crater Eliminator Is Used

Operation of arc welding with a *Stroco* crater eliminator control is not difficult. The instrument is mounted directly on the arc welding generator and is connected in series with the windings of the excitation field. A small flexible cable of approximately the same length as the welding cable (and preferably attached to it) runs from the eliminator to the electrode holder and terminates there in a three-position button switch. With the button in the neutral position, the eliminator is inactive and the operator

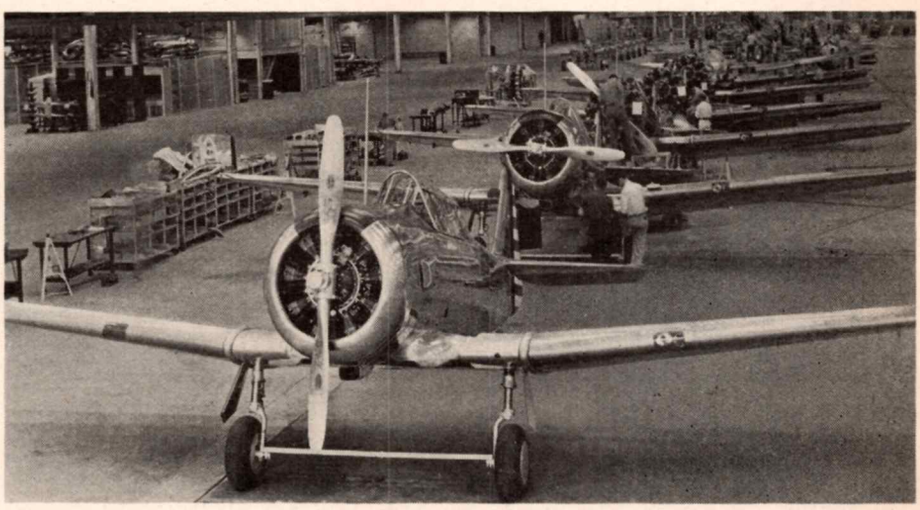


Fuselage mid-section assemblies of North American trainers showing the welded tubular type of structures employed

welds with the customary technique. When he approaches the end of a deposit (within ¼″ to ½″ depending on the thickness of the material) he presses the button backward into the *on* position of the switch housing, while continuing to maintain the conventional arc length and to carry his arc forward. If his manipulation is correct the arc will gradually fade out within a few seconds and no crater will be left. This technique is used whenever a joint is completed or whenever the electrode is about to be consumed so that it is necessary to stop to put a new electrode into the holder.

Another technique is followed when there is a change in the thickness of the material at the joint or when the adjoining tubes are in such a position that a smaller deposit and less penetration is desirable. The button can be retracted to make a slight reduction in the welding current and then advanced into the *off* position so that the remainder of the weld can be completed with reduced current. Conditions may also call for a reduction of the current over a short length of the weld and then a resumption of the normal welding current. This can be accomplished without interruption of the weld deposit by proper manipulation of a conveniently located control button. Another case where this controlled variation of the welding current works to good advantage is when inspection of finished work has revealed defects in the welding. These defects have

(Continued on page 244)



Looking down the final assembly bay, and completed North American advanced trainer planes

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

HYDRAULIC SYSTEM INSTALLATIONS

JAMES E. THOMPSON
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PART I. LINES AND FITTINGS

● If a hydraulic installation design is to be practical, it must be as simple as possible. Every installation should begin with the simplest arrangement that will fulfill the basic requirements, and then be elaborated just sufficiently to develop into a practical production design.

The designer should visualize fully the actual manufacture and installation of each part, and correct the design to reduce the operations involved. Changes in design to suit production requirements can be largely minimized by sufficient preliminary study of the procedures involved in manufacturing and installing a given design. The development of the hydraulic system design should begin with the preliminary design of the airplane, and be thoroughly coordinated with the progress of the airplane's structural design.

The method used to attach an assembly or installation to the surrounding structure is generally influenced by design requirements. Thus the designer should be careful to provide a maximum of accessibility for installation and/or replacement operations. A design which requires the work to be accomplished in cramped, difficult places is fundamentally unsound, and adds to production costs. The designer should always visualize the operations involved in installing each part and assembly, and if these appear difficult or awkward, he should correct the design.

Throughout the design of the installation, the engineer should remember that some degree of inspection and maintenance will be required during the service life of the airplane, and the design should be such that these operations can be carried out easily and quickly.

The principal operations involved in hydraulic system inspection and maintenance are: (1) inspection for leakage, wear and/or damage; (2) removal and replacement; and (3) repair and/or adjustment. Careful thought should be given to each of these.

If proper consideration has been given to ease of assembly and adequate accessibility, little service difficulty should be experienced with removal, replacement or repair of parts. However, the fact that it may be necessary to remove a part or unit from the airplane at any time, for replacement or repair, should always be considered during the development of the design.

Before beginning the study of hydraulic system installation design practices and problems, it is necessary to establish certain basic design factors for the work to follow. Among these are: (1) hydraulic liquid to be used; (2) maximum system working pressure; (3) maximum permissible back-pressure; (4) test pressures; (5) bursting pressures; and (6) maximum and minimum system working temperatures.

All hydraulic systems should be designed to use mineral oil equivalent to U. S. Army Air Corps Spec. 3580 (commonly referred to as Sperry oil) as the hydraulic liquid, and all drawings and purchase orders for parts should specify that the equipment must have packing and seals resistant to this oil. Packings and seals intended for use with other liquids are not always resistant to mineral oil, and their use with such oil could cause failure of the hydraulic system.

Many existing airplanes have hydraulic systems designed for a vegetable-oil base liquid equivalent to U. S. Army Air

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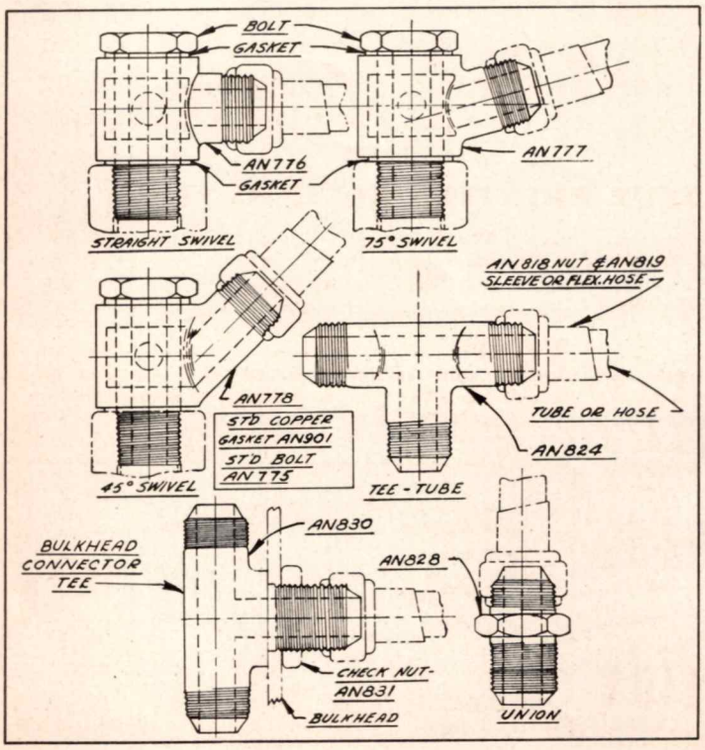
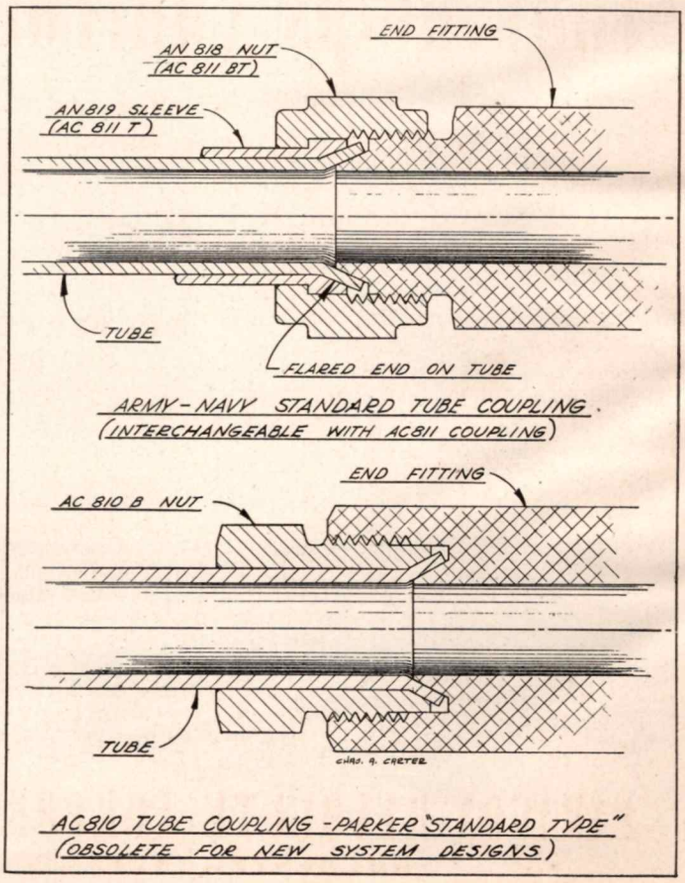
Figure 1: Hydraulic fittings. Figure 2 (right): Cross section of couplings





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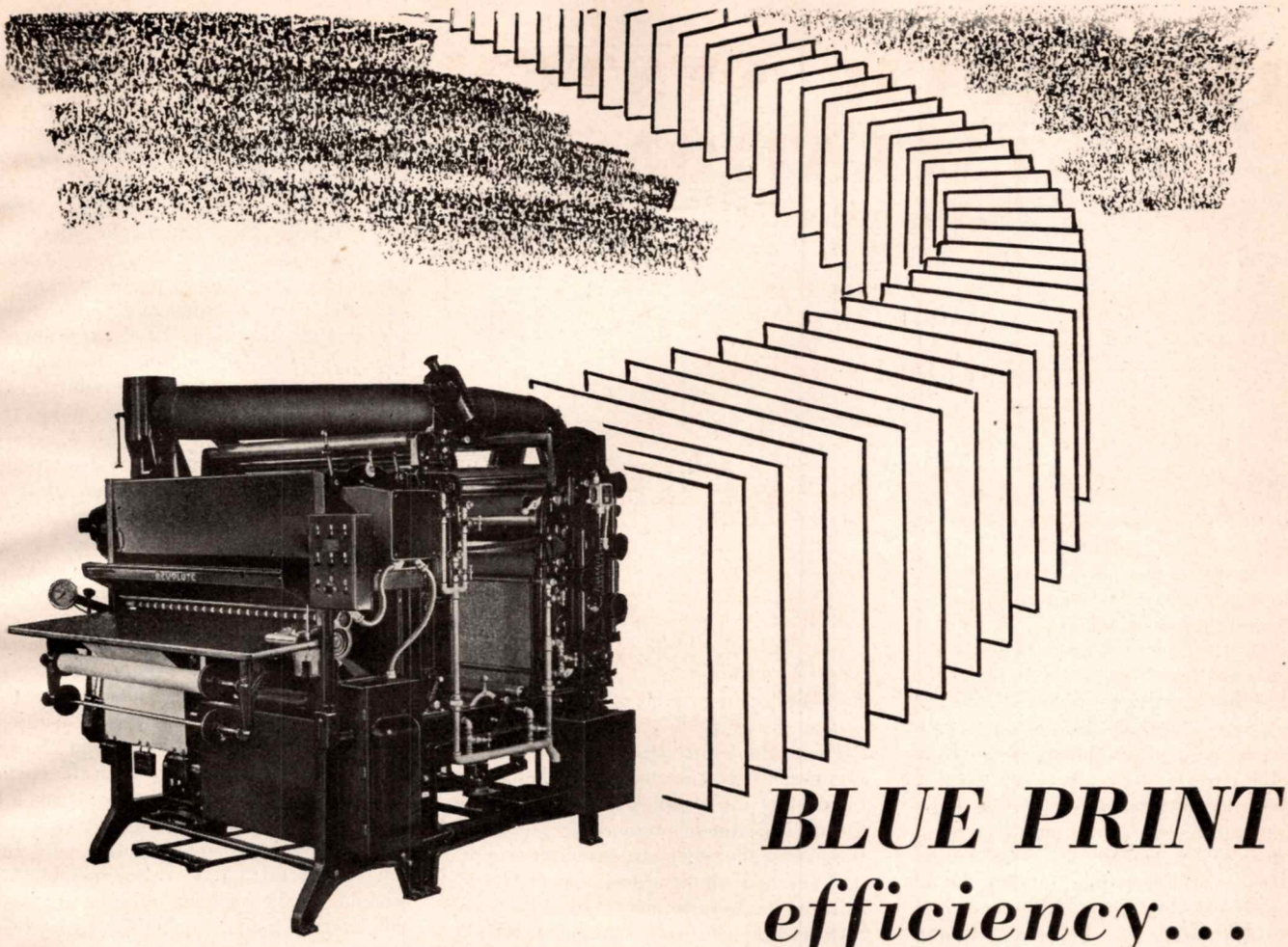

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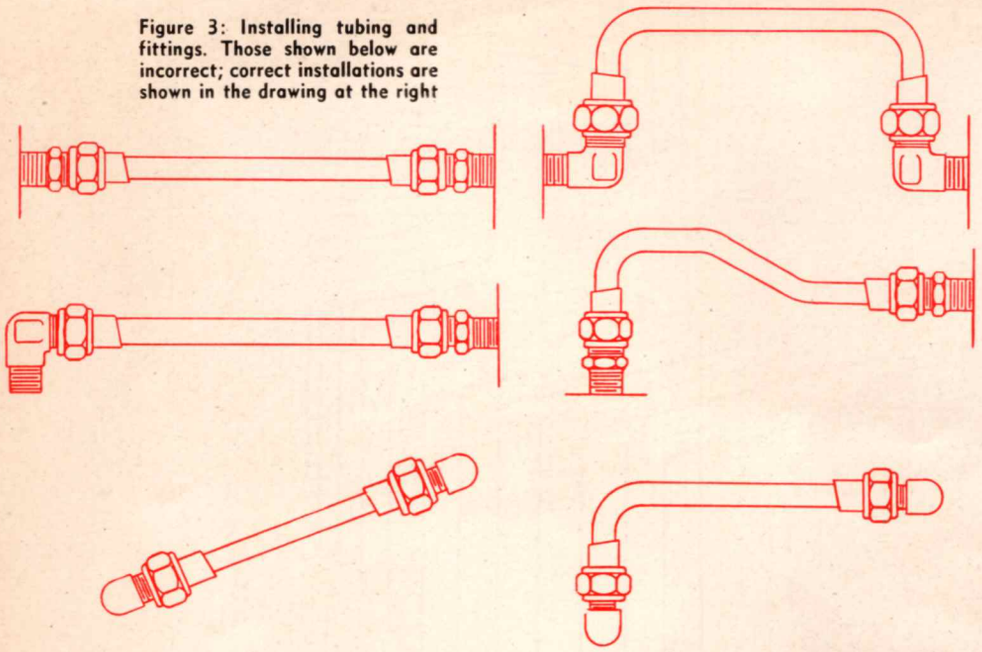

Figure 3: Installing tubing and fittings. Those shown below are incorrect; correct installations are shown in the drawing at the right

(Continued from preceding page)

Corps Spec. 3586 (commonly referred to as Lockheed brake fluid), which consists of a mixture of castor oil and diacetone alcohol. The use of brake fluid for aircraft hydraulic actuating systems has declined in recent years owing to unsatisfactory lubricating qualities rendering it unsuitable for high-pressure systems wherein the hydraulic liquid itself must provide adequate lubrication for the working parts, as well as the low boiling point of alcohol rendering brake fluid unsuitable for high-temperature operation.

The maximum system working pressure should be limited to 1500 psi. The working pressure is defined as being the maximum pressure required to complete one cycle of system operation.

The maximum back-pressure should not exceed 7.5% of the working pressure at 70°F with maximum delivery of all pumps supplying the system. The back-pressure is defined as the pressure in any part of the system communicating with the atmosphere, such as the lines returning liquid to the reservoir.

All parts of the hydraulic system should be capable of withstanding the hydrostatic test pressure noted in the following.

All hydraulic lines, hose and fittings, except those subject to back-pressure or suction only: 2½ times the working pressure or twice the maximum relief pressure in the lines, whichever is the greater, for a period of at least 5 min without evidence of leakage.

Hydraulic lines, hose and fittings, subject to back-pressure only: 18% of the normal system pressure.

Hydraulic units containing air under pressure, such as accumulators and surge cylinders: twice the normal system pressure, or 1.6 times the maximum relief pressure at the unit, whichever is the greater.

Hydraulic units which do not contain air under pressure, such as actuating cylinders, valves and pumps: 1½ times the normal system pressure or 1⅒ times the maximum relief pressure at the unit, whichever is the greater, except at return ports. Return ports (those subject to back-pressure only) should be tested to 15% of the normal system pressure. All tests should be applied for at least two successive times, with an actuation of the unit after each application of pressure.

All parts of the hydraulic system which are subjected to suction should be prooof-tested at 50 psi.

The installed hydraulic system should be proof-tested at 90% of the maximum relief valve setting for a period of at least 5 min without evidence of leakage.

Bursting pressure is hydrostatic pressure at which structural failure occurs. All parts of the hydraulic system should be designed for the following bursting pressures: (1) five times the working pressure or four times the maximum relief pressure in the line, whichever is the greater, for lines, hose and fittings; (2) four times the working pressure or 3.2 times the maximum relief pressure at the unit, whichever is the greater, for units containing air under pressure. Units containing air under pressure should, when fully charged, also be capable of withstanding a .50 cal. machine-gun bullet fired at a range of 100 yd, without fragmentation of the unit; and (3) three times the working pressure or 2.2 times the maximum relief pressure at the unit, whichever is the greater, at the pressure ports of units which do not contain air under pressure. Return ports (those subject to back-pressure only) should be tested for 30% of the working pressure. Ports subject to suction only should be capable of withstanding an externally applied pressure of 50 psi.

The design must be planned for satisfactory operation of the hydraulic system at all temperatures within the range of −40°F to +160°F.

Hydraulic lines should be identified at both ends, and at intervals of 3 ft along the length of extensive lines, with parallel bands of blue and yellow paint or identification tape. Each band should be ½" wide. The normal direction of flow in all lines should be indicated at each end, and at intervals along the length of extensive lines, by black arrows of sufficient size to be readily discernible. Lines having a normal reversal of flow, such as actuating cylinder lines, should be marked with arrows showing flow in both directions.

Metal parts of the hydraulic system installation, with a few exceptions, should be finished (painted, lacquered, *etc.*) to match the surrounding structure when such finish is desirable for the sake of appearance. Surfaces subject to corrosion should be finished in accordance with standard aircraft corrosion-prevention practices, except as follows: (1) no finish should be applied to surfaces in *constant* contact with the hydraulic oil; (2) cadmium plating should not be used on rubbing surfaces of internal parts, including springs in contact with hydraulic oil; (3) springs in contact with the hydraulic oil should be given a thorough coat of hydraulic oil before assembly, or a coat of heavy grease before storage; and (4) actuating cylinder piston rods, which should be hard-chrome plated and buffed to a mirror finish.

Standard Lines and Fittings

In the past, there have been several Army and Navy specifications covering fittings, couplings and hose for hydraulic installations, but recently there were issued a number of Army-Navy Standards covering hydraulic fittings, tube couplings, and flexible hose for both Army and Navy aircraft. These components only will be considered here, as the previous components are now obsolete for design purposes, and are well covered by readily available drawings and catalogs. Figs. 1, 2 and 4 show the current Army-Navy Standard fittings, couplings and hose assemblies. Dimensions are not given for these as it is necessary to refer to the Air Corps Standards Handbook to obtain the correct tube-size dash number for the component desired, and therein will be found completely dimensioned drawings of each part.

Our system installation will use these AN (Army-Navy) standard components, in order that it may meet Government requirements, and to provide definite

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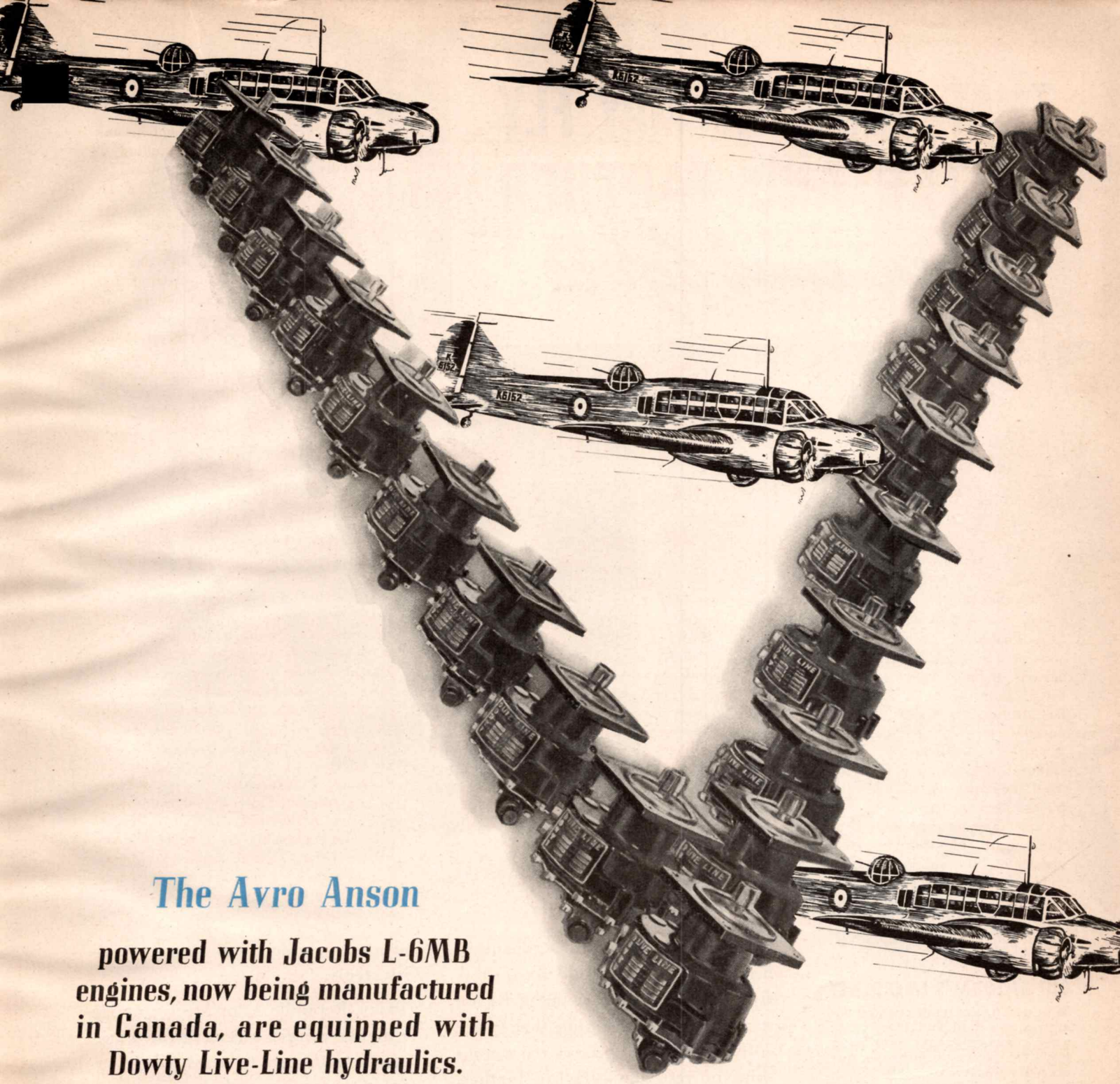
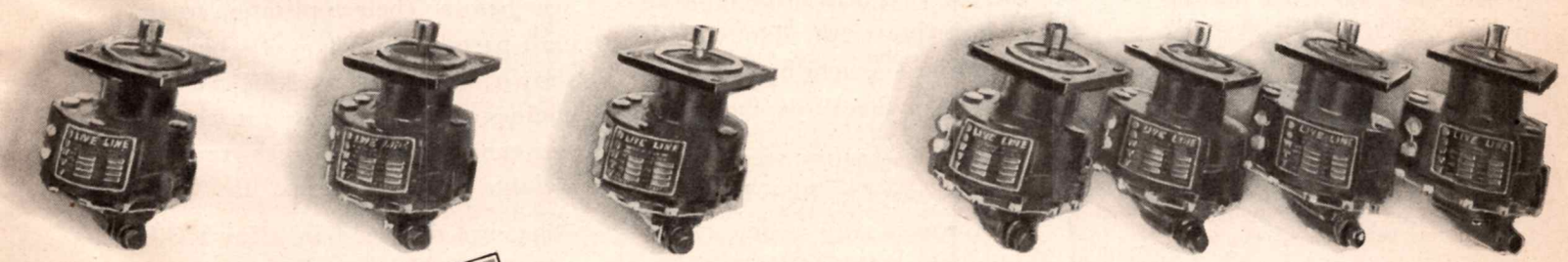
See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



The Avro Anson

powered with Jacobs L-6MB engines, now being manufactured in Canada, are equipped with Dowty Live-Line hydraulics.



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R. J. Wysor
PRESIDENT

Gone from the skies into aeronautical history are the now ponderous, slow-flying bombers that we admired not so long ago. And taking their place —flying with the speed of the pursuit ships of yesterday—flying farther, too, and carrying heavier bomb loads —are sleek, powerful planes made possible to large extent by the use of Republic Alloy Steels for vital parts.

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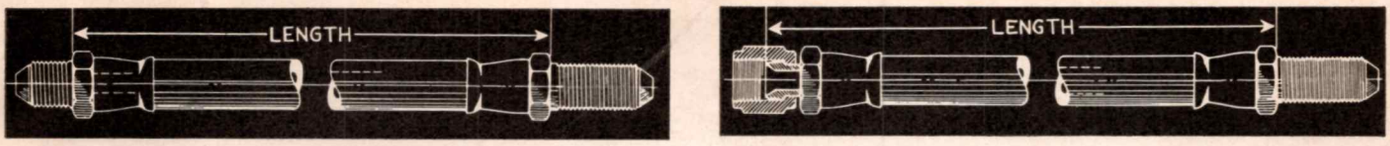


Figure 4: AN standard hydraulic hose with flared tube connections; swivel connection above

(Continued from preceding page)
control of the quality of the components used by specifying and ordering these to conform with AN standards.

Fig. 1 shows the swivel-fitting and bolt type of coupling used to connect lines and hose to the system units. This form of coupling permits connection of the line at any angle of rotation about the bolt-center, and replaces the pipe-thread fittings formerly used. A soft-metal gasket is used as a seal between clamping surfaces of these fittings, and concentric grooves or serrations are provided in the clamping surfaces to insure a satisfactory seal of the gasketed joints. The serrations provide a larger contact area for the clamping surfaces and insure against the gasket being forced out of the joint when pressure is applied.

The AN standard coupling for connection of tubing to flexible hose and/or hydraulic units is a compression-type flared-end tube coupling, similar to the Parker "triple type" series, and involves a sleeve and nut for connection of the tube flared end to a male boss provided with a tapered end-connection to receive the tube flare. This coupling is shown in fig. 2, and is formed by slipping nut and sleeve over the tube-end, flaring the tube-end with a special flaring tool, applying the tube flare to the fitting with the sleeve against the flare, and using the nut to securely clamp the flared tube-end between boss and sleeve. In this manner, the flared end is relieved of torsion or "wiping" loads during tightening, and deformation and/or splitting of the tube flare is avoided.

Two forms of AN standard flexible hose assemblies suitable for aircraft hydraulic systems are illustrated in fig. 4. The two are identical in general design, but one is provided with two threaded male ends, and the other is provided with one threaded male end and a union-nut on the opposite end. Each type of hose assembly is provided with one long threaded male-end. This is for securing that end to a bracket on the airplane structure by a lock-nut. Both ends of the hose assemblies provide for standard tube flares.

Hose assemblies should not be specified for the exact calculated length, as it is necessary to allow for 3½% average shrinkage of the hose length during its service life, and a tolerance of ± ⅛" on the length of the manufactured hose assembly.

Bonded cushion clamps are used to secure the hydraulic lines at a majority

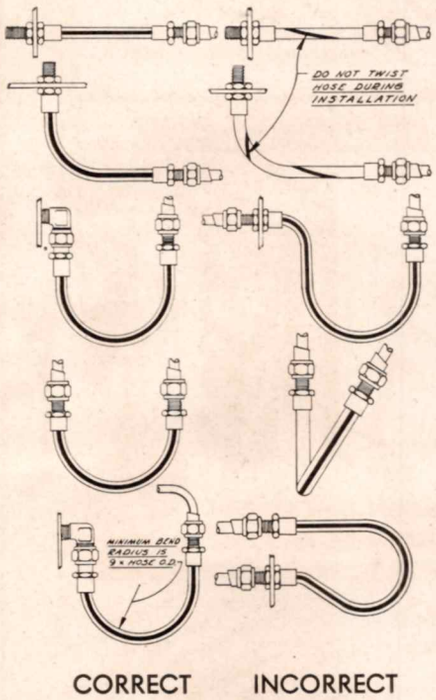


Figure 5: Installing hydraulic hose

of the attachment points. The use of such clamps is shown in fig. 7, wherein bonded, loop-type, cushion clamps are shown. These clamps provide a vibration-absorbing cushion for the tube, to eliminate fatigue and mechanical damage at the attachment point. A thin metal tongue is concentric with one-half of the clamp's inside diameter to provide electrical bonding. Bonded cushion clamps are also manufactured with the clamping lugs parallel to the centerline, rather than tangential as with the loop-type shown in fig. 7.

Installing Lines and Fittings

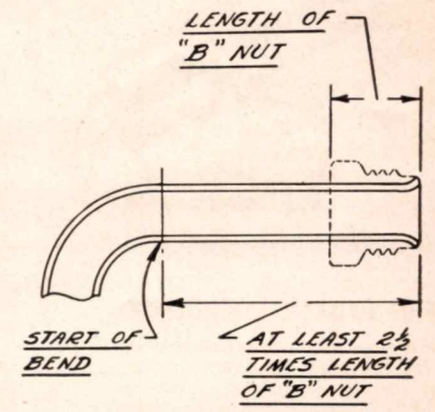
No tubing other than 52SO aluminum-alloy or 18-8 stainless steel in the fully annealed condition should be used for hydraulic system plumbing. The outside diameters of these should be in accordance with the standard sizes listed in Table 2. The wall thickness will be governed by the maximum working pressure, but in no case should it be less than .032" for aluminum-alloy tubing, nor less than .022" for stainless-steel tubing, to properly resist mechanical damage incident to handling and installation.

The tubing installation should be planned to eliminate unnecessary bends and fittings to reduce production expense and installation time. Every tube should be designed for pre-forming, and bench-assembly of its couplings, to minimize installation time and permit stocking of complete tube assemblies for production and repair purposes. In no case should it be necessary to form a tube at installation in the airplane, and under no circumstances should a tube be installed during assembly of a structural component of the airplane in such a manner that partial disassembly of the basic structure is necessary to permit removal and replacement of the tube.

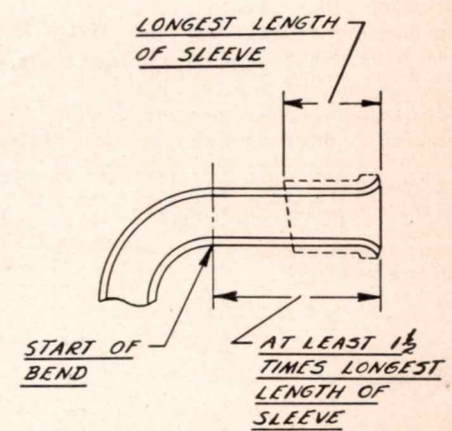
Each tube assembly and circuit should be planned to avoid local high-spots in the lines. These might result in air traps, and interfere with proper bleeding of the system. This is particularly important with hydraulic brake system lines.

Dual lines used to provide emergency operation of mechanism in the event of failure of the basic system must be separated from each other as far as practicable, to minimize the possibility of damage to both by a single projectile.

The fundamentals of tubing and fit-



Parker "standard" type fittings



"AN" type fittings

Figure 6: Minimum distance from tube end to bend

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

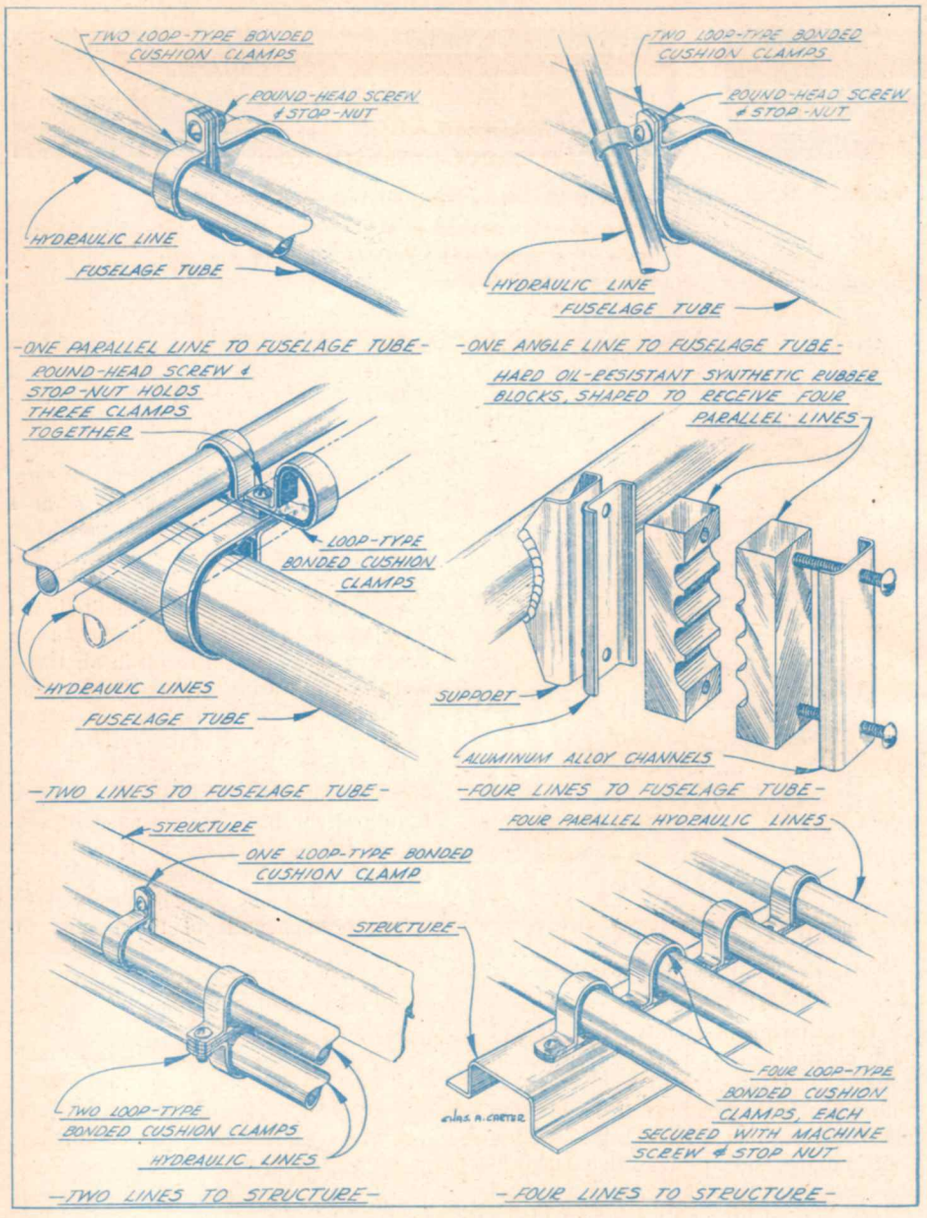

TWO LOOP-TYPE BONDED CUSHION CLAMPS
ROUND-HEAD SCREW & STOP-NUT
HYDRAULIC LINE
FUSELAGE TUBE
-ONE PARALLEL LINE TO FUSELAGE TUBE-
TWO LOOP-TYPE BONDED CUSHION CLAMPS
ROUND-HEAD SCREW & STOP-NUT
HYDRAULIC LINE
FUSELAGE TUBE
-ONE ANGLE LINE TO FUSELAGE TUBE-
ROUND-HEAD SCREW & STOP-NUT HOLDS THREE CLAMPS TOGETHER
LOOP-TYPE BONDED CUSHION CLAMPS
HYDRAULIC LINES
FUSELAGE TUBE
-TWO LINES TO FUSELAGE TUBE-
HARD OIL-RESISTANT SYNTHETIC RUBBER BLOCKS, SHAPED TO RECEIVE FOUR PARALLEL LINES
SUPPORT
ALUMINUM ALLOY CHANNELS
-FOUR LINES TO FUSELAGE TUBE-
STRUCTURE
ONE LOOP-TYPE BONDED CUSHION CLAMP
STRUCTURE
TWO LOOP-TYPE BONDED CUSHION CLAMPS
HYDRAULIC LINES
-TWO LINES TO STRUCTURE-
FOUR PARALLEL HYDRAULIC LINES
FOUR LOOP-TYPE BONDED CUSHION CLAMPS, EACH SECURED WITH MACHINE SCREW & STOP NUT
-FOUR LINES TO STRUCTURE-

Figure 7: Typical supports for hydraulic lines

ting installation are shown in fig. 3. The prime difference between the correct and incorrect examples is that the former provide for expansion of the tubing due to temperature changes, and for a small amount of misalignment and variation in length. The latter necessitate tubes and fittings being perfectly aligned precise lengths, and expansion or contraction from temperature changes would impose loads on tube and fittings.

Fittings used with aluminum-alloy tubes may be of either aluminum-alloy or nickel steel; those for stainless-steel tubes must be of nickel steel.

All male straight threads and copper gaskets on fittings should be coated with a thread lubricant equivalent to a mixture of 8 parts white lead, 1 part petrolatum and 1 part graphite by weight.

Upon installation of tube connections, care should be exercised to keep the wrench torque used to assemble each joint within limits shown in Table 1.

Bends should be uniform (without kinks), and the minimum bend radii must not be less than those specified in Table 2, with the minimum distance from tube ends to bends being in accordance with the data shown in fig. 6. Bends should be made as close to clamps as possible to minimize overhang of the line from a straight line between clamps.

The tubes must be secured to the airplane structure with tube clamps similar to those shown in fig. 7, with maximum spacing between clamps not exceeding those specified in Table 3, excepting that where the lines support fittings such as unions, tees, and the like, these spacings shall be reduced 20%. Where lines of different length are tied together, average lengths may be used.

All units, such as relief valves, check valves, and the like, whose weight is more than 25% greater than that of the corresponding size of line fitting having the same number of tube connections, should be supported by means other than by the tubing.

Hydraulic hose assemblies should be installed in accordance with the general principles illustrated in fig. 5, with particular attention being directed to avoiding torsion of the hose. Hoses should be installed in such a manner that they are not subjected to torsional deflection (twisting) under any condition of operation. Where hoses attach to rigid tubing, supports should be provided which relieve the line connections of all loads, except internal pressure. When the hose is supported by a bracket over the male hose end, or by a bulkhead, it should be fastened by a standard AN 831 lock nut. Sufficient clearance should be provided in the hose installations to allow for the maximum hexagon dimension specified for these nuts.

Hose assemblies should be so installed and supported that there will be no tendency to loosen their connecting fittings. The minimum radius of bend in any operating position must not be less than 9 times the *outside* diameter of the hose.

Hoses must be protected against chafing, where necessary, by a suitable cover or boot. *(To be continued.)*

Table 1:—Allowable Tightening Torque for AN Standard Couplings

Tube O.D. (inch)	Tube Flare O.D.	Wrench Torque (inch-pounds) 52S0 Tubes	18-8 Tubes
3/16	.296- .311	——	30- 70
1/4	.343- .358	40- 65	50- 90
5/16	.406- .421	60-100	70-120
3/8	.469- .484	75-125	90-150
1/2	.640- .655	150-250	150-250
5/8	.765- .780	200-350	——
3/4	.921- .936	300-500	——
1.00	1.171-1.186	500-750	——

Table 2:—Normal Tube Sizes and Minimum Bend Radii for Hydraulic Lines

Tube O.D. (inches)	Minimum Bend Radius Measured to the Tube Centerline (inches)
3/16	0.75
1/4	1.00
5/16	1.00
3/8	1.25
1/2	1.50
5/8	1.75
3/4	2.00
1.00	3.00

Table 3:—Hydraulic Line Support Spacings

Tube O.D. (inches)	Max. Length Between Support Centers (inches measured along tube) 52S0 Tubes	18-8 Tubes
3/16	12	14
1/4	13 1/2	16
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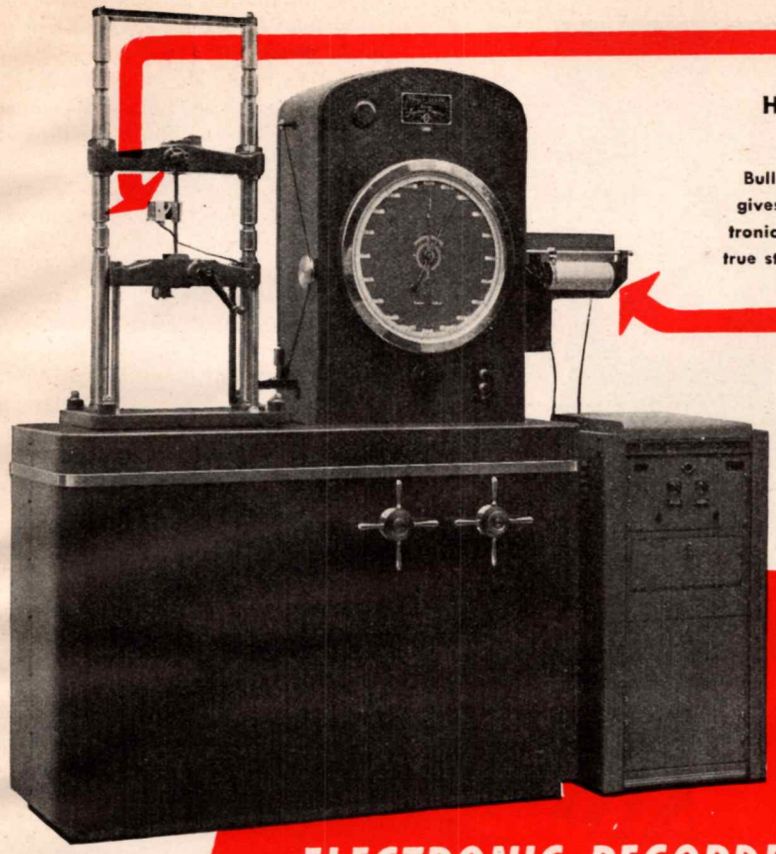

HIGH MAGNIFICATION ELECTRONIC RECORDER-EXTENSOMETER

Bulletin 18 — Write today for your copy which gives complete description of the Olsen Electronic High Magnification Recorder — assures a true stress-strain diagram.

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HERE is the ideal Universal machine for testing wire, rod, and sheet. Illustrated is the 20,000 lb. machine of new modern design, hydraulically operated with mechanical pendulum weighing, and multi-masked range selector dial. This machine has three capacity ranges—2,000, 10,000 and 20,000 pound maximum, all equally accurate. Can be made with higher columns for testing longer specimens (up to 3 feet) in tension and 12 inches in compression with 15 inches between columns.

The Olsen High Magnification electronic recorder-extensometer assures the most accurate recordings and does not require a highly skilled operator. This instrument is fool-proof and needs no attention even if a specimen breaks unexpectedly. The recorder follows minutely and simultaneously the elongation both at a constant and a varying speed.

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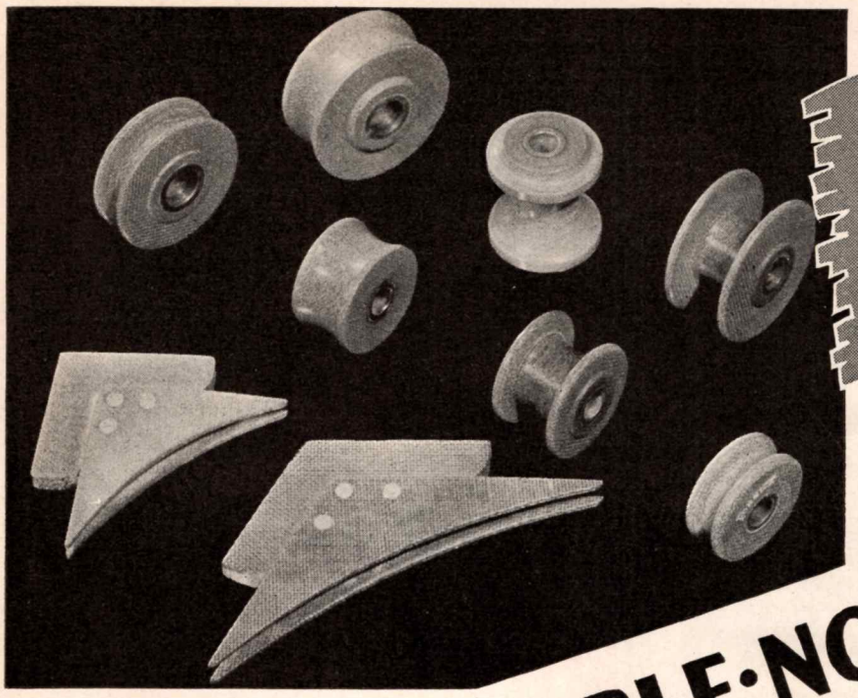
See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



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STRONG·STABLE·NON-METALLIC PARTS for AIRPLANES ...

Low Thermal Expansion

AIRPLANE manufacturers have been finding that Formica is more and more useful to them, and have been specifying it for many more parts every year. They like its light weight, and its stable dimensions which are due to low moisture absorption and a low coefficient of the thermal expansion; they like the fact that it is inert chemically and will not react with the atmosphere to corrode or deteriorate in any way. It is capable of being accurately machined — and maintains its dimensions under extreme variations in conditions.

The very great variety of parts that is now being made by and for the airplane industry is illustrated in a new catalog of "Formica Parts for Airplanes" which we will be glad to send on request. Ask for your copy.

• The Formica Insulation Company
4618 Spring Grove Ave. • Cincinnati, Ohio

FORMICA

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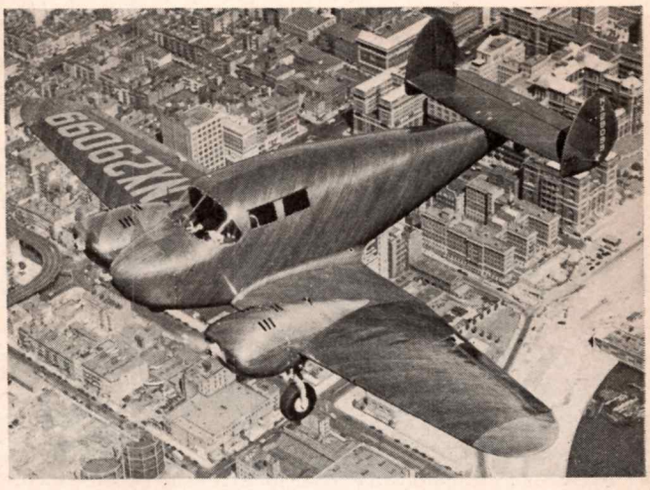
THE TWIN-ENGINED 4-PLACE "LANGLEY"

Built by a New Structural Process of Fused Plastics and Mahogany Plywood



The "Langley" in flight over New York City

● Newest entry in the plywood aircraft field is the 4-place twin-engined *Langley* manufactured at Port Washington, N. Y., by the recently formed Langley Aircraft Corp. Designed by Martin Jensen and built under the engineering direction of ex-Navy Pilot Arthur F. Draper, the airplane employs a new structural process by which plastics fuse layers of mahogany under heat and air pressure.

In the Langley process the plywood sheets are not prefabricated, bent and attached to stringers or bulkheads as are other types of construction. Thin strips of plastic-treated veneer are molded into an integral unit comprising the structure and the skin.

The molded plywood parts of the Langley monoplane are multiple layers of veneer in strips ranging from 1/64" to 1/8" in thickness, formed over a mold and permanently bonded together into a single structure by plastic compositions which react to heat and pressure.

Fuselage, wings, control surfaces and cowling are joined without the use of fastenings such as nuts, bolts or screws. In place of dies, parts are formed on relatively simple wood molds, prefabricated strips of veneer being placed over each other upon the forms while dry. On the mold, parts as big as half a fuselage are placed in a sack of rubberized fabric, each veneer layer being sealed so the grains of wood are at right angles to each other. The parts are then placed in a heated pressure chamber for 60 min or less.

The resulting structure is simple, easy to inspect and cheap to maintain and service. Each engine cowl, wing tip and the fuselage nose is removable as a unit. Cowls and firewalls are molded with an integral asbestos lining, although the plywood alone has shown itself to be exceedingly flame resistant.

Plastic plywood is impervious to corrosion by acids, alkalis, salt water and fungus. The Langley product has been tested without signs of weakening in temperature extremes from —40° to 160°F.

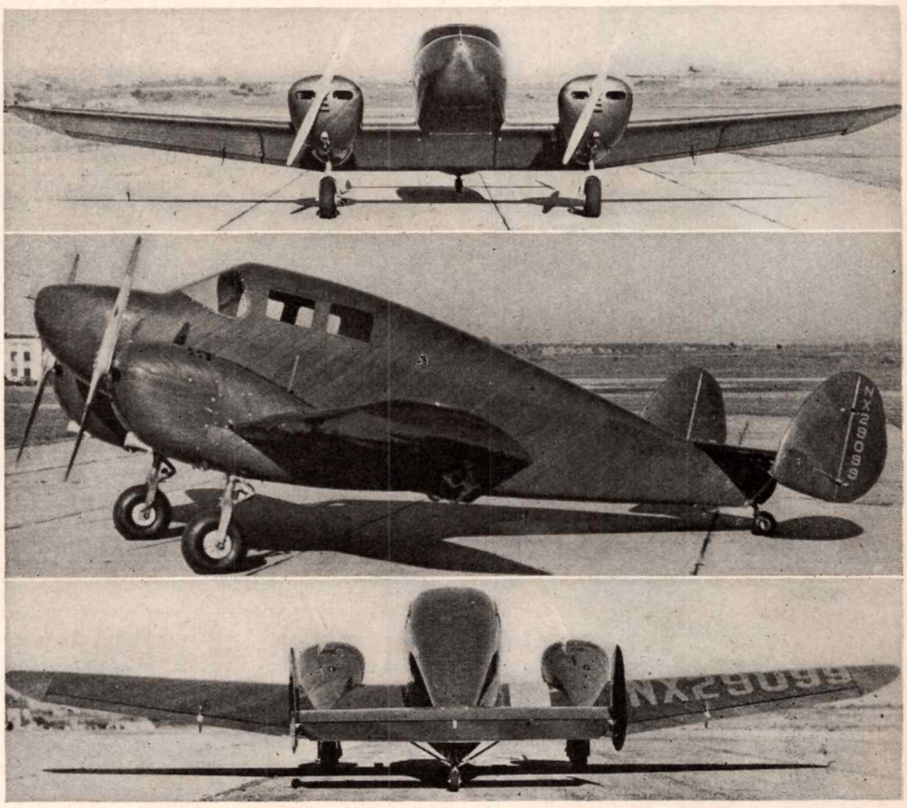
The Langley is powered by two 65 hp Franklin air-cooled engines. In tests so far, it has taken off in 200 ft and landed at 46 mph. A second craft, now under construction, will use two 90 hp Franklin engines and is designed for a maximum speed of 165 mph and a cruising speed of 148 mph.

Heading the Langley corporation as president is Caleb S. Bragg; vice presidents are Draper, Daniel E. Sickles and Harold Strotz; treasurer is W. Horace Schmidlapp. With the officers as directors are Jensen and John P. V. Brennan.

Manufacturer's performance and specifications data for the Langley with the 65 horsepower engines follow:

SPECIFICATIONS

Wing span	35 feet
Overall length	20 feet 6 inches
Overall height	7 feet 1 inch
Empty weight	1410 pounds
Gross weight	2300 pounds
Fuel capacity	40 gallons
Maximum speed	142 miles an hour
Cruising speed	125 miles an hour
Landing speed	46 miles an hour
Rate of climb (full load)	644 feet per minute
Service ceiling	15,000 feet
Cruising range	600 miles



Front, side and rear views of the twin-engined "Langley," a low wing monoplane manufactured at Port Washington, N. Y.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

ASSEMBLY, MAINTENANCE AND REPAIR OF BRITISH MILITARY AIRCRAFT

J. I. WADDINGTON, M.A., A.F.R.A.I.S.

RAF mechanics in Singapore assembling Brewster "Buffalo" fighters

● When Great Britain first began ordering aircraft from the American plants, the only American aircraft which were generally known in England were the Lockheed and Douglas airliners. These had so impressed themselves on the British by the excellence of their design and workmanship and by their safety and reliability in service, that when the pre-war expansion of the RAF began the British experienced satisfaction in knowing that trainers, fighters, bombers and flying boats of the same quality could be acquired from across the Atlantic to augment their own growing aircraft production.

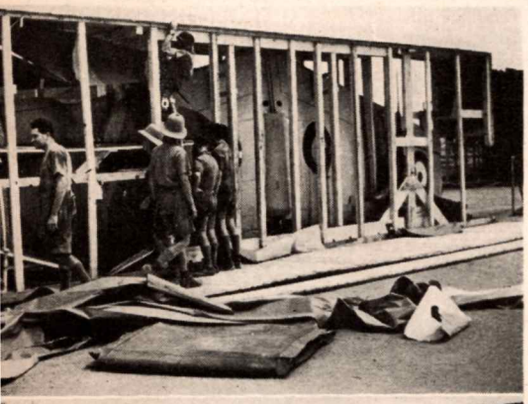
As a result of this new purchasing policy, however, an organization had to be built up in England to handle the shipment, packing and assembly of complete aircraft. In the early days this created no serious problems since the British were then importing a comparatively small number of aircraft a month. There were a few North American *Harvard* trainers and Lockheed *Hudson* reconnaissance planes, but when Hitler started the Panzers rolling into Poland, the U. S. really started the airplanes avalanching into Britain. There was no time to lose in leaving them on docks or fields in boxes once they had arrived. This urgency was emphasized when France collapsed.

The problem was complicated. Britain had taken over all outstanding French orders and had placed its own for nearly all the available production types of American military and naval aircraft. During the early rush period, quick decisions had to be taken as to the manner of dealing with this sorely needed equipment. When the news came through of the French Armistice, one French ship was intercepted in mid-ocean by British warships in June, 1940, and was taken to a Scottish port. Packing cases on her deck were opened and found to contain Douglas DB-7's.

A north country American aircraft assembly unit was immediately contacted and the Resident Air Ministry official arranged to have the cases rushed to the unit. Within 48 hours the first DB-7 was out of its case, assembled, repainted with British markings, and was ready to fly away.

Unfortunately, the actual assembly of the aircraft was only a small part of the job, particularly regarding the French orders and the aircraft bought direct from the U. S. Army Air Corps. The biggest job was to arm and armor the aircraft to RAF combat requirements and to install British radios and other special equipment. For instance, American and French aircraft had to be fitted with many more guns than they had been designed for, but this was only one of many difficult problems dealt with by the hard-pressed assembly units.

All photos courtesy British Press Service



Curtiss "Tomahawks" being uncrated and assembled at a Royal Air Force unit in the Middle East

Uncrating and Assembling Aircraft

Today, the smaller types of trainers and fighters usually arrive in packing cases, one or two cases for each airplane according to the packing technique used. The current types included in this category are the Curtiss Hawk P-40 *(Tomahawk)* pursuit; the Grumman *Martlet* and Brewster *Buffalo* fighters and the North American *Harvard* trainer.

The *Tomahawks*, which are doing such good work in the Middle East, are excellent examples of the assembly procedure which has been developed to give rapid production. Each is packed in two cases. One case contains the fuselage (complete with engine) resting on a steel structure built into the case and picking up on the wing attachments on the fuselage. Separately packed in the same case are engine cowlings, fin, rudder and propeller. In the other case are the wings, landing gear struts, wheels and the streamlined wing fillets.

As soon as the cases arrive they are opened and a mobile crane transports the fuselage to its line in the assembly shops where the protective grease is cleaned from the airframe and engine. The fin and rudder are assembled and the fuselage is raised by an overhead crane and then lowered on the wing, the units are then bolted together. While still on the trestles the undercarriage controls are connected

(Continued on following page)

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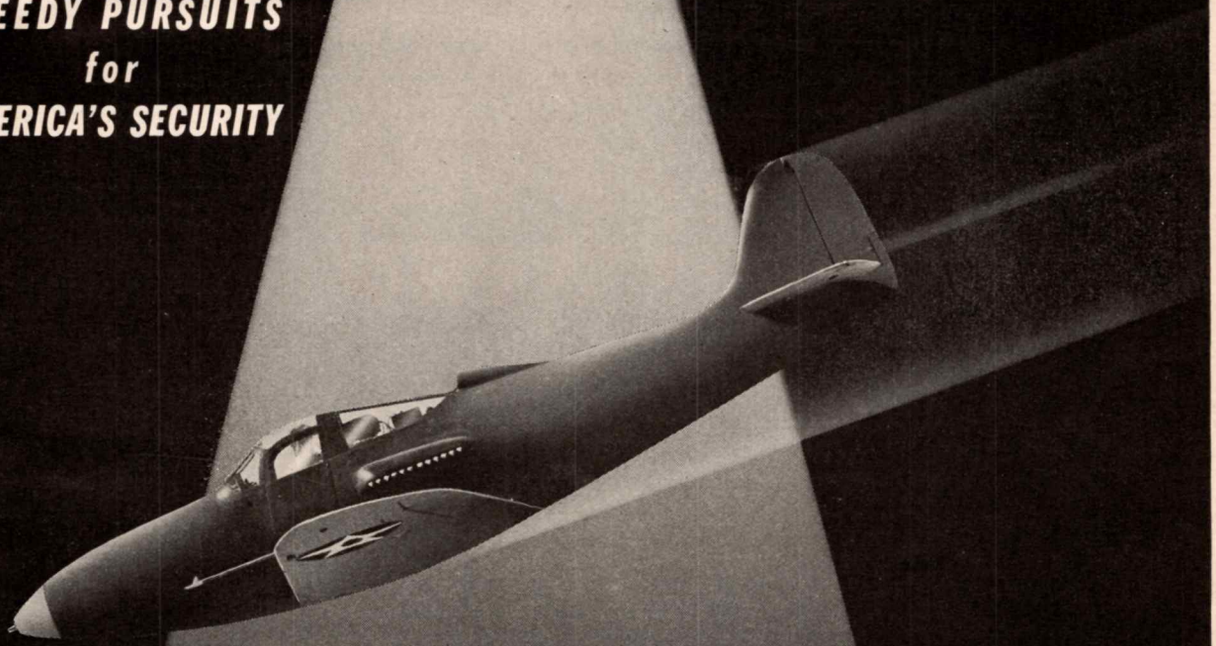
for
AMERICA'S SECURITY



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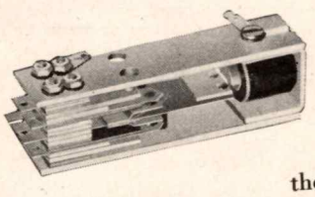
Electronic Engineers
Can Help You With Your Electrical Problems

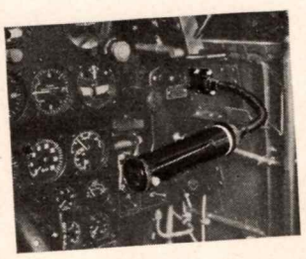
● Many a key defense-producing company has come to Electronic to solve electrical design and manufacturing problems of vital importance in America's planes, battleships and other defense equipment. They have found a highly-trained, experienced, and amazingly resourceful engineering company that was able not only to *develop* what was needed, but to *manufacture* it as well! Civilian supply manufacturers have also found this true, time and time again. This kind of help is available to *you*, too, at Electronic Laboratories.

* * *

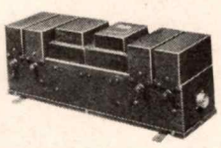
Below are described some of Electronic's important products. Look them over — some of them may help solve a problem for you *now!*



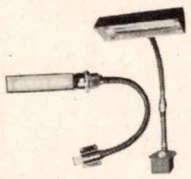
The Heavy-Duty Vibrator . . . one of the many and varied products manufactured by Electronic . . . heart of the Electronic Converter as used in the Sperry Directional Compass . . . combines light but rugged construction . . . constant frequencies . . . synchronous operation . . . range up to 500 watts at any voltage . . . long, trouble-free performance!



Ultra-Violet Black Light for aircraft instrument illumination . . . produced solely by Electronic . . . is required equipment on new planes for U. S. Army Air Corps, U. S. Navy, and U. S. built planes for the R.A.F. Illustrated is Electronic Type X-206 lamp assembly installed in cockpit of Bell Airacobra.



Electronic Autosyn Inverter Type S-525 converts 12 Volt DC to 45 Volt AC as power source for instruments of the great Boeing Flying Fortress. Electronic's exceptional performance and long service life . . . even at extreme altitudes encountered by sub-stratosphere bombers . . . is attested by the fact *more* Electronic Power Supplies are flying *than all other makes combined.*



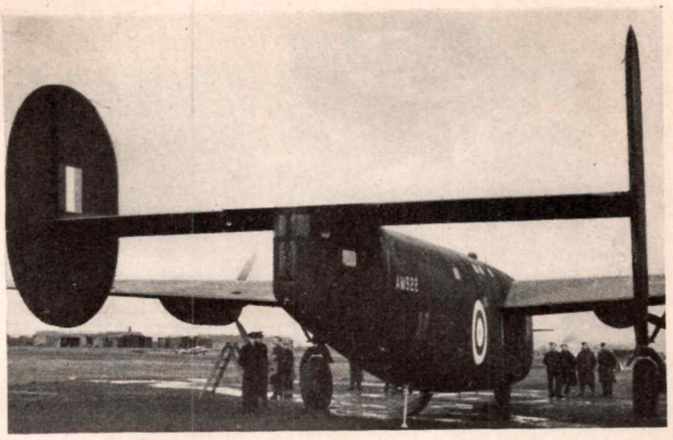
Fluorescent Cabin Lighting for both aircraft and ships brings you daylight at night . . . *abundant* light that lets you see better, reduces eye strain and fatigue . . . *yet the current drain is only about half that of ordinary lighting.* Illustrated is the X-211 and X-209 flexible-arm Lamp Assemblies as used on Naval aircraft, cruisers and yachts.

For further information, address the Aircraft Division of Electronic Laboratories, Inc.

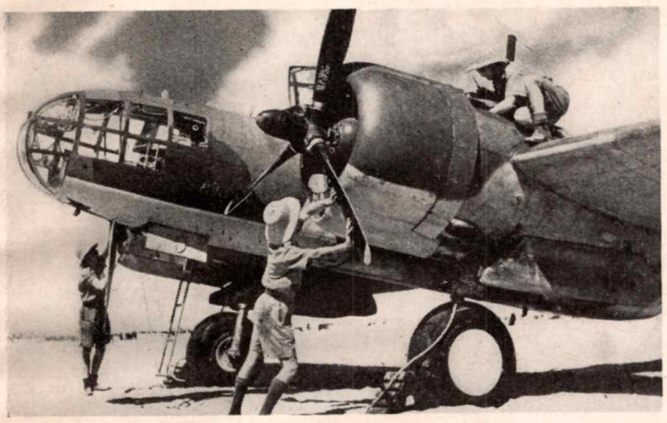
ELECTRONIC LABORATORIES, INC.

AIRCRAFT DIVISION, INDIANAPOLIS, INDIANA

"Tomahawk" taking off on patrol over the Western Desert



Four-engined Consolidated "Liberator" flown across the Atlantic



Ground crews check up a Martin "Maryland"

Lockheed "Hudsons" of the RAF Coastal Command

(Continued from preceding page)
and tested; wiring circuits are completed and fairings fitted. The engine is checked and tested and then the airplane is ready for its routine test-flight and delivery to the RAF. Simultaneous with the assembly of the aircraft, the special equipment in armor, guns, radio, etc., is being installed in the aircraft.

Aircraft such as the Douglas DB-7 and the Lockheed *Hudson* are frequently flown to England, but when they are shipped on surface vessels they cross as deck cargo and sometimes arrive scarred by the machine gun bullets of convoy raiders. But they are soon reconditioned and prepared for service. As deck cargo their wings, fins and rudders, elevators and stabilizers are detached and stowed below. The fuselages stand on the undercarriages; engines are canvas-cowled and all doors and windows are sealed against the effects of wind and sea. Arriving in port, they are craned direct from the ship's deck to the quay-side and towed by tractor through the streets to the nearest assembly unit. There they undergo an assembly routine similar to that given the smaller types.

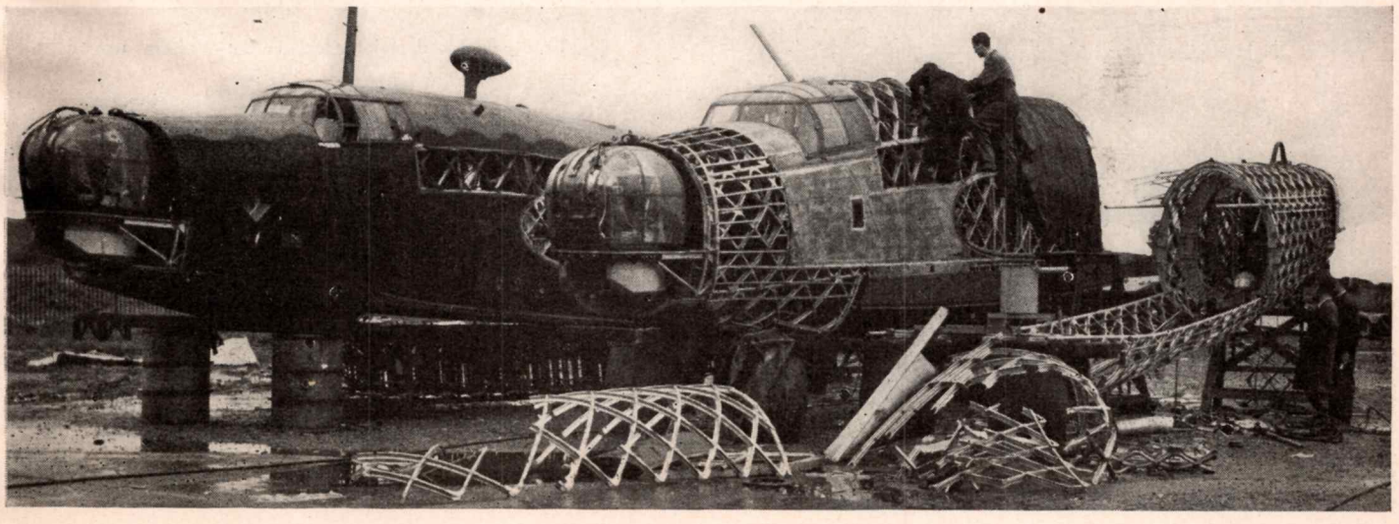
Since the Consolidated *Liberator* and Boeing *Flying Fortress* bombers always fly directly to their destinations, the only work which has to be done on them is the installation of operation equipment. However, now that more American aircraft are being flown to England equipped to English requirements, the assembly question is becoming less of a problem to the British ground staffs.

Repair and Maintenance

In a large and constantly growing active Air Force such as the RAF, composed of many different types of aircraft, the functions of repair and maintenance assume an increasingly vital part in keeping the offensive and defensive arms operationally at high efficiency. Although this program is somewhat complicated by the use of American as well as British types of aircraft, the RAF nevertheless has set up an organization which has attained outstanding success in its work. It is an organization which of necessity must be widespread and flexible, function under a well developed routine for maintenance and at the same time be

Battle-scarred "Wellington" bombers are flown to repair depots where they are inspected, stripped and overhauled

British Combine



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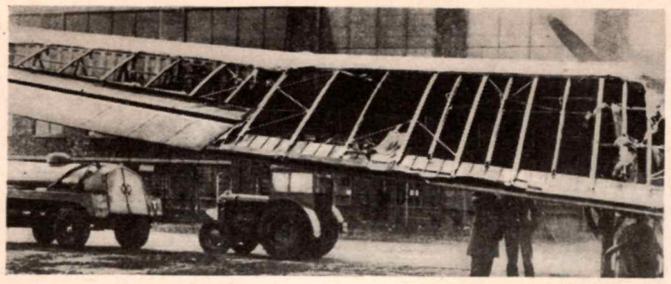
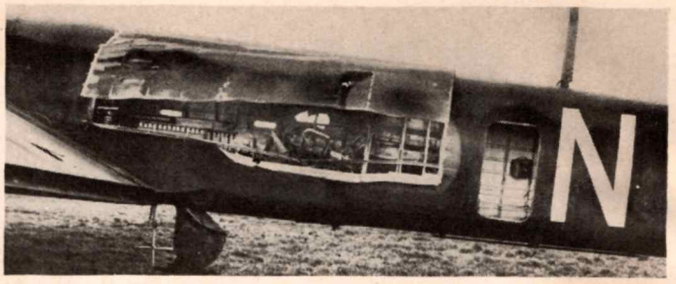
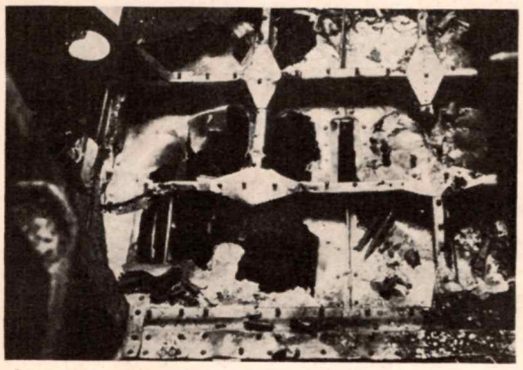


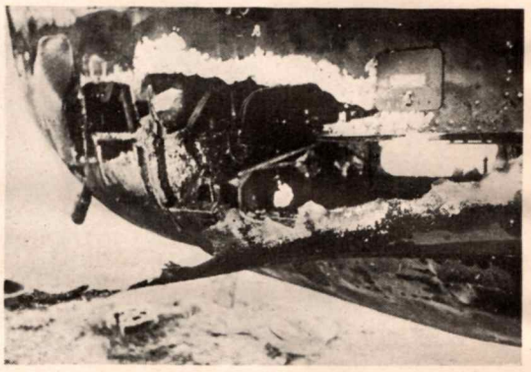
A British aircraft as it reached home with both wings damaged



British heavy bomber hit by a fragment which penetrated its fuselage



A shell-torn plane photographed after the pilot had landed. Photo at left shows exploded ammunition in cockpit; at the right hole made by the shell when it struck the rear gunner's turret



prepared to undertake diverse and difficult repairs under difficult working conditions over the whole area of air operations. In addition, it also assures that adequate reserves are always available and that the period of unserviceability of any aircraft is reduced to a minimum.

For the RAF operating from British bases the control of all repair and maintenance is vested in a single group which in turn controls a number of maintenance units located in different parts of the country. In certain of these units, chosen for geographical or other special reasons, there are salvage and repair units which are provided with an imposing complement of such specialized equipment as mobile workshops and cranes, light utility vans for the transport of personnel, trucks for equipment, and 60-ft long girder trailers on which complete fuselages and wings are brought back to base when extensive repairs are required.

When an aircraft is finally checked out by the manufacturer it is delivered to a maintenance unit. There it is stored (probably out of doors) until required for service, and in the interim it is carefully maintained. Engines and cockpits are covered with canvas; all parts susceptible to corrosion are treated with anticorrosives; and fuel, oil and liquid-cooling tanks are drained.

If the stay is going to be of short duration, no inhibitor or anti-corrosive treatment is used on the engine but the latter is turned over frequently to avoid the possibility of local corrosion.

Modifications and improvements to aircraft or their equipment are continuously being introduced and it is another of the many responsibilities of a maintenance unit to see that every aircraft in their care is changed to meet the latest requirements.

On arrival at its operations squadron the airplane is again checked thoroughly and armament and radio are installed. Routine inspections are made before and after every flight.

Regular inspections for normal wear and maintenance show when replacements become necessary. These replacements are requisitioned from Squadron Stores and if these are not available there, from a main Stores Depot. If the parts are not in stock at any of the RAF stores, they are ordered directly from the manufacturer of the airplane who carries large current orders for spares and who must on demand divert the particular spares required to the original squadron.

Far more spectacular, but no more important than the regular routine of scheduled inspections, is the salvage and repair of crashed aircraft. Reports on these aircraft indicate the extent of the damage, and the aircraft is then classified into one of a number of specified categories. These cover crashes which can be repaired in the field—and which do not exceed 24 hours to complete by

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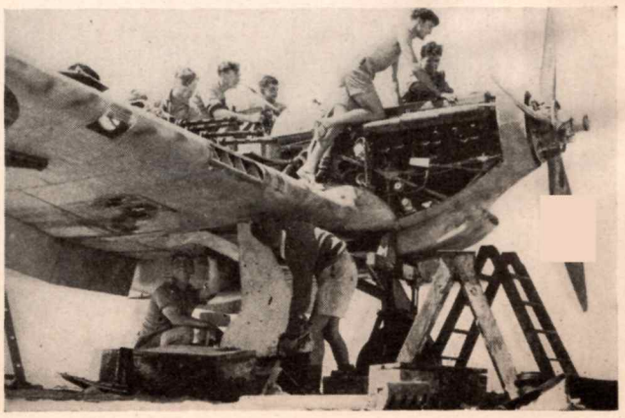
Fighter pilot supervising the loading of his guns

Routine overhaul and maintenance in the Western desert



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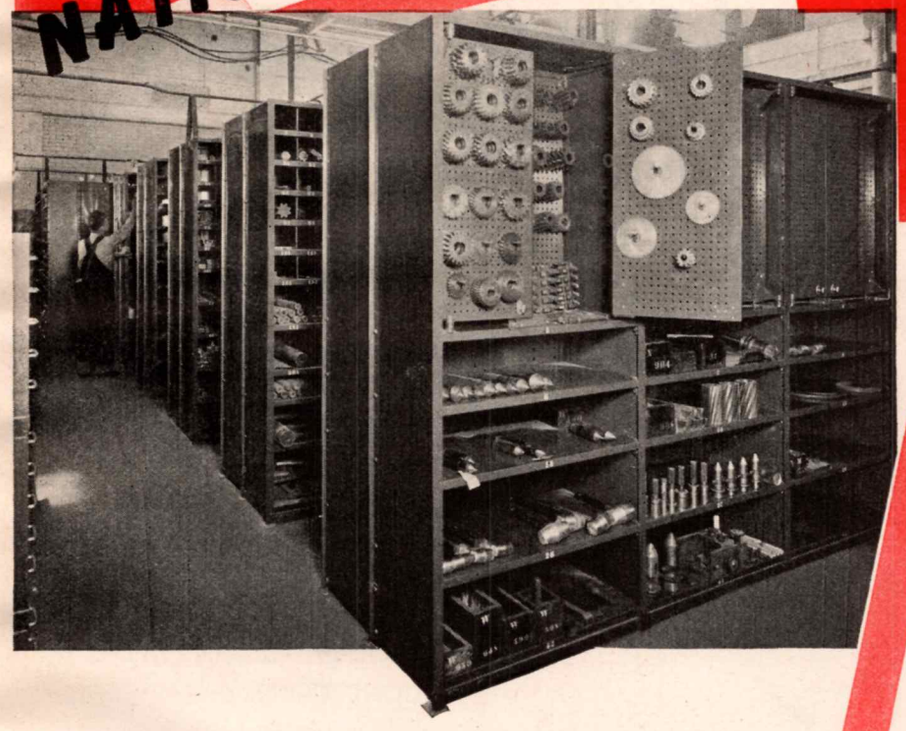
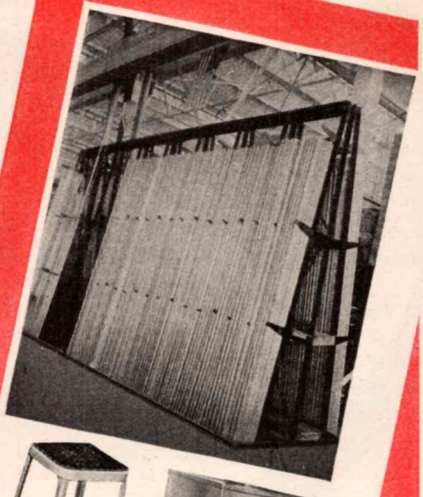
Here's How Lyon Products HELP SPEED UP NATIONAL DEFENSE PRODUCTION





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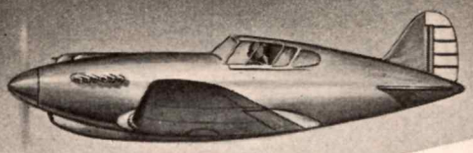
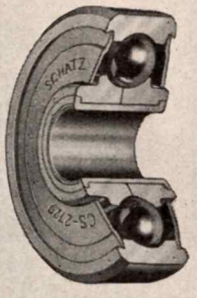


Go With Schatz for Progress



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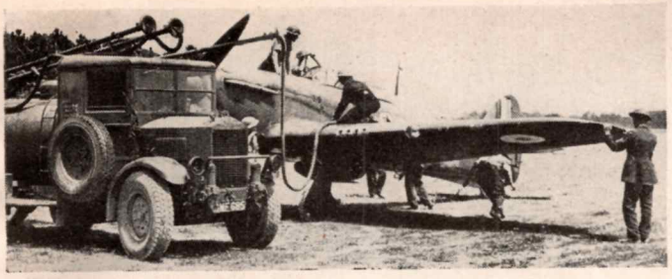

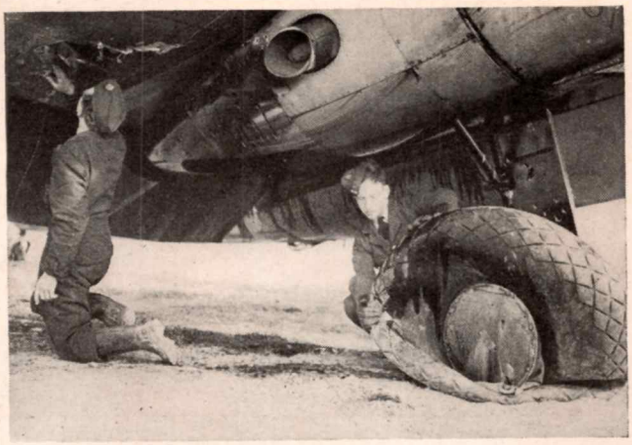

Refuelling a "Hurricane" which had just returned from patrol in France, and, (right) a Lockheed "Hudson" of the RAF Coastal Command which received a direct hit from anti-aircraft guns; shell pierced both wings, and shrapnel spattered the fuselage, engine and tire

(Continued from preceding page)

the working party sent out from the unit; those which can be transported to base or, after temporary repairs, flown there for the job to be completed. Still other aircraft must be transported to the manufacturer for rebuilding; and then there are those which are beyond repair. These latter are sent to salvage units where they are stripped of every usable part; what is left is "reduced to produce."

The salvage process of crashed aircraft is a job which is quite as extensive as it is important. It might call for the complete stripping of the damaged component down to its smallest integral parts, or a smashed fuselage, a crumpled wing or a wholly written-off machine.

Literally everything is used again; nuts, bolts and washers are separated, cleaned and sorted according to size and material; plumbing, electrical circuits and junction boxes are segregated; undamaged details, tires, wheels and shock-absorbers, all swell the pile of "bits and pieces" which after rigorous inspection are sent to a manufacturer for use in a new aircraft.

In addition to the service maintenance units there is a civil repair organization which undertakes similar work. Frequently these organizations are operated in conjunction with the parent aircraft manufacturing firm.

The actual repair plans devised to cope with the type of crash which experience has shown to be probable are usually arranged by the design and engineering departments of the aircraft manufacturer who also prepares information showing the limits to which the structural members may be damaged and yet retain sufficient strength to sustain the airplane for a flight back to base. Other plans indicate the type of patch repairs which will restore the strength of a bullet- or shell-ridden spar to that required for safe flight. All probable structural failures are considered, so that just as soon as a crash is reported, the working party can proceed to the job knowing roughly what material and equipment will be required to effect the necessary repairs.

PRECIPITATION STATIC

(Continued from page 58)

ting antenna, but it is silly to take chances. If one is within or near thunderstorm activity, it is only electrical prudence to keep the aircraft as small electrically as possible. It would not be wise to discharge a static tube, and wisdom suggests retraction of any trailing antenna system during such a condition. Only future disclosures of data still to be accumulated may prove the wisdom or folly of such procedure but it is better to play safe than be sorry.

In the years which have passed since the first pilot made himself rather unpopular with radiomen by reporting "rain static," instrument flight of aircraft has become the rule rather than the exception. With this increase of instrument flight, airfoil and propeller de-icers, carburetor heaters and alcohol de-icers, windshield de-icer alcohol jets and defrosters, and pitot tube de-icers have become standard equipment on aircraft designed for all-weather flight. These aircraft also carry one and preferably two electrostatically shielded loop antenna and one or preferably two static discharge tubes. Instrument flight during the winter invariably invites icing, though pilots avoid ice conditions as much as possible. Icing invariably entails precipitation static and a pilot cannot fly instruments safely without having constant navigational radio signals.

Today, two-way communication with the ground is of equal importance with navigational radio to provide airway traffic control information on conflicting traffic and clearances. Thus precipitation static problems are now doubly important. It wasn't long ago that anyone on instruments gave no thought to traffic; today it is a serious problem.

Fortunately, the shielded loop antenna and static discharge wire appear to complement each other. That static which the loop does not clear is usually cleared by the discharge wire, and *vice versa.* This complementary situation provides nicely for the average condition but one occasionally encounters the need for two-way communication in heavy precipitation static under warm air conditions, where the shielded loop provides navigational radio but not high frequency reception. Then the troubles of modern instrument flight appear in full force. Perhaps the transition from medium high to ultra-high frequencies now taking place will relieve the pilot of these problems. The ultra high frequencies appear thus far to be free of precipitation static interference. However, only time will provide the answer, aided by the assistance of flight personnel and the patience of radio engineers.

EDITORIALS

(Continued from page 48)

ties on almost everything else relating to national defense. Men, mail and materials for national defense depend on the airlines for swift transportation. The government would be remiss in its duty to the nation if it permits continuing but preventable waste of this time-saving transport medium.

Another problem plagues the airlines—the "rush hour" flights. Around noon and late afternoon between four and six, flights are generally filled, while those in mid-morning, early afternoon, or evening periods usually have space available. Perhaps these earlier or later flights would be just as convenient on some occasions. The airlines suggest that when you are traveling by air you ask them to quote you all of the available service to the point you wish to reach. Then, if possible, choose a mid-morning, early afternoon, or early evening plane rather than one in the rush period.

The reservation of seats on airliners is a service that the traveling public would be well advised to cherish and protect, and not abuse lest it be taken away from them much sooner than it may be eventually.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

Cylinders are inspected for accuracy of the bore

QUALITY CONTROL

Checking and Inspection Procedure In the Production of Wright Engines

A. A. TUMSER

Quality Manager, Wright Aeronautical Corp.

● Quality control of every phase of the detail parts is considered a prime requisite in the manufacture of aircraft engines. This control comprises the checking and inspection of every step in the production of these parts for compliance with engineering blueprints and specifications, for detecting flaws and defects in the materials used and for seeing that the general mechanical appearance of the product as a whole is satisfactory and up to standard both from the manufacturer's and from the customer's point of view.

A manufacturing organization that takes pride in the performance of its product and which expects to continue to do so must have a quality control organization, or in other words, an inspection department. In order to function properly, this organization must be in absolute control of all phases of production in the organization, wherever the question of quality is to be determined, and the quality department's decisions should be subject only to the control of management.

In the Wright Aeronautical organization it is realized that management, engineering, production, sales and service equally share with quality control, the responsibilities for the product, and that each in its own field has a man-sized job to perform. Only in plants where this principle is recognized is the quality department able to do a real job of inspection and be of actual value to the entire organization.

The job of inspecting the various parts that go into the making of *Whirlwind* and *Cyclone* engines has been made increasingly difficult because of the rapid expansion of the industry to meet national defense needs. Starting with a small but well organized inspection force, it was necessary to expand to take care of a rapidly increasing production without neglecting or letting down standards of quality. In a period of approximately 18 months, this inspection force increased from 224 to the present day total of 1189.

This increase had to go hand-in-hand with the expansion of inspection facilities in order to handle the increased volume of production. It was accomplished by reorganizing the various inspection departments, subdividing the work and putting inspectors who showed promise of executive ability into the new supervisory positions. This called for the training and initiation of many new inspectors, a program in which the company was assisted to a great extent by the Paterson Vocational School which supplied quite a number of trainees for this purpose.

In the functional organization of the quality department, the quality manager reports directly to the general manager

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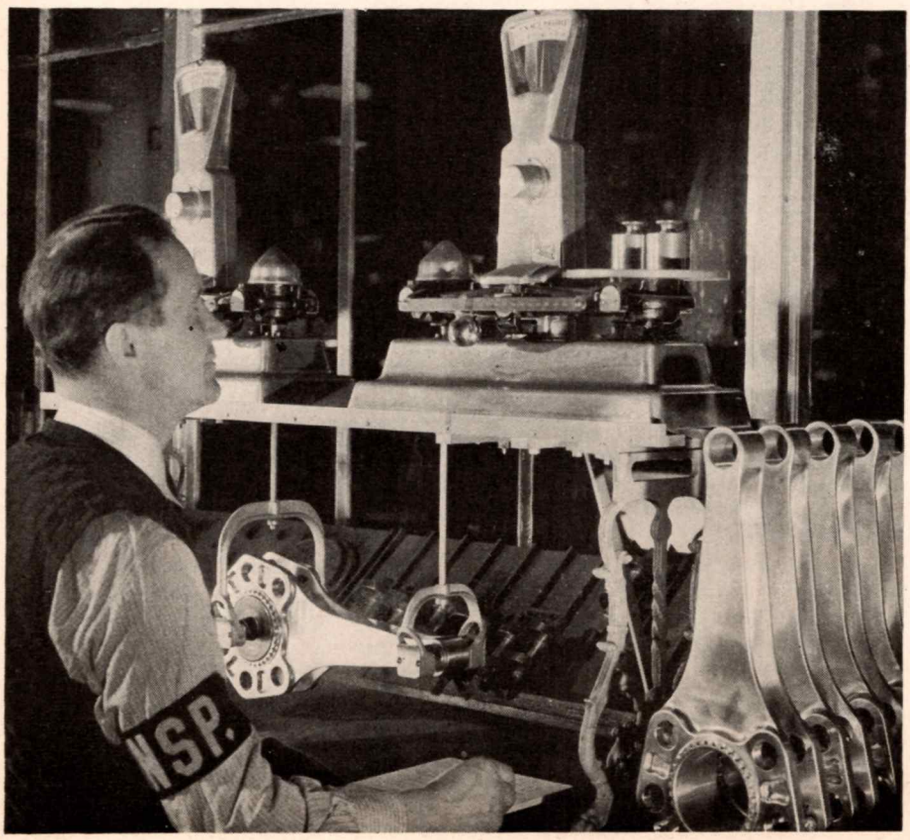
After going through several critical inspections for dimensions, each master rod is weighed on this double scale



See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

P.R. MALLORY & CO. Inc.

MALLORY Complete Contact Assemblies

Often Solve Many Problems at Once!

Mallory's activity in the production of complete contact assemblies has grown out of a natural demand which no one else was so well equipped to fulfill. Frequently, questions concerning the design of the contact member . . . the material to be used for proper tension and lowest resistance . . . the method of attaching the contact to the member . . . as well as many similar questions have proven to be serious obstacles to complete electrical efficiency.

It was natural then that Mallory with its broad experience in the electrical and physical characteristics of non-ferrous alloys . . . and with unlimited facilities for experimentation, design and research should be called upon to provide the answer to such questions with increasing frequency.

Today . . . Mallory offers as a standard service . . . complete contact assemblies for every electrical operation. This may include anything from the permanent attachment of the contact points to your own contact members . . . or the complete specification, design and manufacture of assemblies.

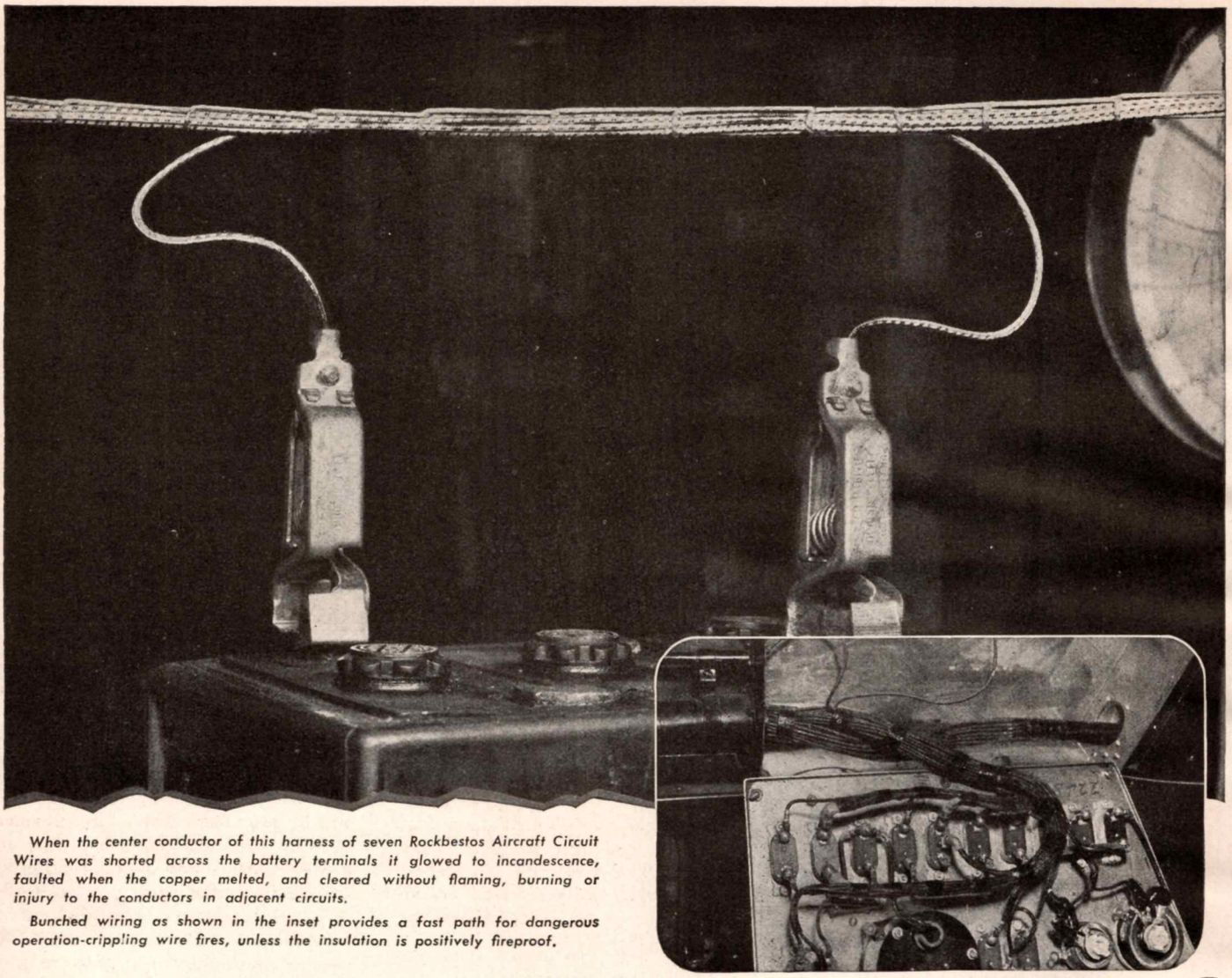
Ask your Mallory representative to give you the whole story.

Do You Have the Mallory Contact Catalog?

Your technical library is missing an important and valuable reference if you do not. It covers the entire field of materials and design of electrical contacts for every service. Write for your copy today.

P. R. MALLORY & CO., Inc., INDIANAPOLIS, INDIANA Cable Address—PELMALLO

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



When the center conductor of this harness of seven Rockbestos Aircraft Circuit Wires was shorted across the battery terminals it glowed to incandescence, faulted when the copper melted, and cleared without flaming, burning or injury to the conductors in adjacent circuits.

Bunched wiring as shown in the inset provides a fast path for dangerous operation-crippling wire fires, unless the insulation is positively fireproof.

"Where There's Smoke There's FIRE"...?

Shorts and open circuits in an airplane electrical system can happen in a variety of ways—vibration, for example, is a common cause.

When a wire shorts to ground it may be thrown across the full battery current. The copper heats rapidly and if the insulation is of the usual types it soon bursts into flame. Wires with inflammable insulation thus provide a ready path for the spread of fire, even through conduit, and are especially hazardous where conduits are eliminated and wires are installed open. By the time the copper melts and opens the circuit the fire may have gained considerable headway.

But these wire fires can be avoided. While shorts and grounds cannot always be controlled *an additional safety factor* can be built into an airplane by wiring it with Rockbestos Fireproof Aircraft Circuit Wire. Under conditions of a direct short circuit, Rockbestos Aircraft Wire gives off smoke, unavoidably, but at no time is there any flaming or burning *whether or not* the conductor burns clear.

You can make a simple test of this yourself with a storage battery and a length of wire which we'll supply. Then you'll see what we mean by *a real fireproof wire.*

This wire, the original fireproof aircraft circuit wire—has also the wanted characteristics of low weight and small diameter. Rockbestos Bulletin 53-A contains all the figures and data. For a copy and a sample of the wire address Rockbestos Products Corporation, Mitchell Drive, New Haven, Connecticut.

No. 8 AWG 133/.0112 FLEXIBLE STRANDED ROCKBESTOS FIREPROOF AIRCRAFT CIRCUIT WIRE

ROCKBESTOS—*specialists in heatproof and fireproof wires*

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

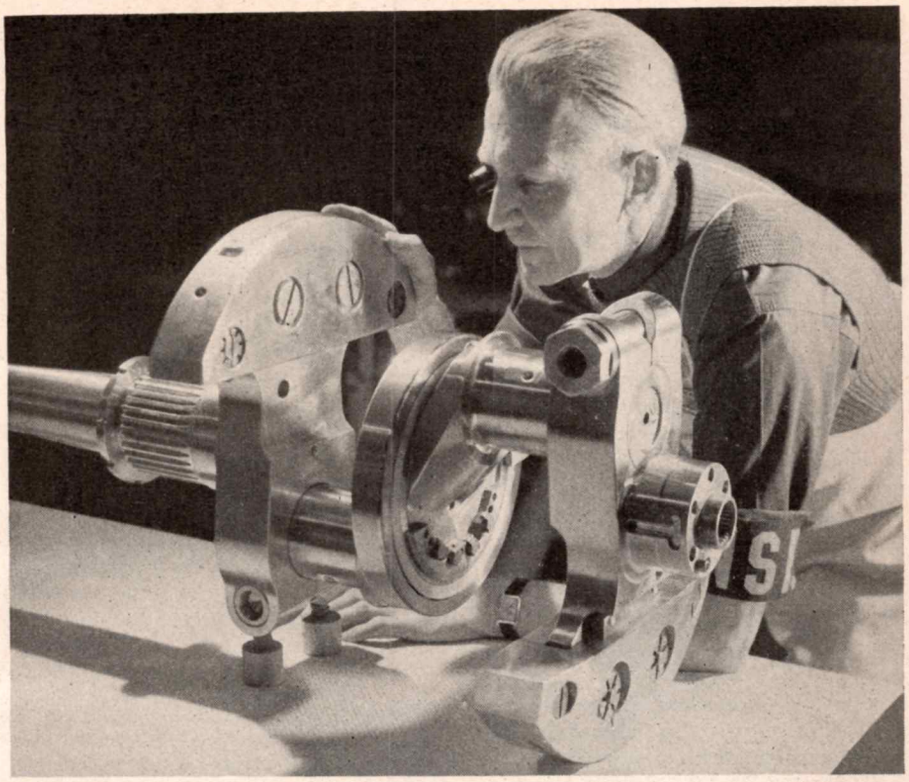
(Continued from preceding page)

of the company, and is in charge of all branches of the inspection department. Directly under the quality manager are two chief inspectors, one handling the inspection functions of the manufacturing division, and the other, all the inspection functions of the assembly, test, packing and service division. Under the chief inspectors are supervising inspectors responsible for the inspection functions in the various plants and departments of the corporation. Under the supervising inspectors are inspection foremen and leadmen in charge of groups of inspectors in each manufacturing department. In addition, the quality manager has an aide whose function it is to follow all the trouble reports emanating from the assembly and service departments, and also from the shop supervising inspectors. This aide is also in charge of the salvage department and reports directly to the quality manager.

Raw Materials Inspection

All raw material, such as forgings, bar stock, tubing, castings, fuels, lubricants, *etc.*, upon receipt from vendors or foundry, are delivered to the raw materials inspection crib, where samples are prepared as prescribed by the specifications and delivered to the laboratory for chemical and physical analyses. All materials are held in raw materials inspection crib until results of analyses are approved and officially released by the laboratory. While awaiting laboratory results, castings and forgings are given a thorough check, in order that they may be released for production immediately upon receipt of laboratory approval. The first casting made from each pattern is carefully sectioned and a complete layout made before a release is given to proceed with the job. Likewise on forgings, a lead cast is submitted by the vendor and a complete layout made of it before an approval order is given to the vendor to proceed with the forgings. Approval of flow lines by the laboratory for each new forging is a prerequisite for releasing this forging for production use.

Records are kept by the raw materials inspection department of all materials inspected. This is done by assigning a lot number to each heat or lot of material received and identifying the material with this lot, and also all paper work connected with this material, so that at any time during the processing of the material in the shops, it can always be identified.



Inspector using a jeweler's glass to make visual inspection of a double-row crankshaft

Vendor Inspection

Purchased finished materials, such as valves, valve springs, spark plugs, piston rings, magnetos, carburetors, bearings, and other miscellaneous small purchased parts are delivered to the vendor inspection crib where they are inspected to blueprint and specification requirements, both by the inspection department and by the laboratory, before delivery to finished stores. In this department are about 90 girls who are efficiently trained in the inspection of smaller parts such as studs, nuts, rollers, valve guides, *etc.*

A brief description of the inspection procedure on a few of the more important parts handled by this department will be given here. Valves are instrumentally inspected for dimensions, and visually for surface defects. Concentricity of the stem and the valve seat is checked in a special fixture. The angle of the valve seat is held to close limits and checked by bluing in a gauge in which the angle has been checked by tool inspection. Intake valves are also magnetic inspected to disclose flaws in the steel not visible to the naked eye.

Valve springs are checked for tension in the open and closed position of the valve and also for solid height. A new type spring checking machine checks the squareness of the spring under load (an important item on valve springs) and in one setting checks the open and closed positions of the spring for tension.

Spark plugs are bomb tested under 150 lb nitrogen. They are checked for thread size and squareness of thread to

Parts for Whirlwind and Cyclone engines are produced on a straight-line basis in the Wright Aeronautical Corp., Paterson

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the gasket flange in a special fixture.

Bearings are checked for out of round condition and for surface finish, and some of the leaded bronze bearings are x-rayed to check the uniformity of the bearing structure and for flaws under the surface. All master rod bearings are x-ray inspected.

Due to the urgency of the defense program considerable quantities of finished machined parts which under ordinary circumstances would be made in Wright's own shops are now being purchased outside. These parts are checked for compliance to blueprint requirements and also by the laboratory for compliance to specifications in regard to chemical and physical tests. These parts are, as a rule, identified by a letter or combination of two letters to show who the machining vendor is, to distinguish them from Wright's own production.

Other purchased parts, such as fixtures, tools, gauges, *etc.*, are routed to the tool inspection crib where they are checked for dimensions and quality, before being released for production use. In this department it is necessary to have the highest grade of skilled tool inspectors and also the most accurate measuring devices available, since tolerances on tools and fixtures must be extremely close. It is necessary to use special equipment, such as optical measuring devices, projectors, shadow gauges and constant pressure special micrometers, Class A gauge blocks, *etc.*, in order to insure accurate checking of these tools.

One of the important functions of the inspection department is in manufacturing control. For this purpose, floor inspectors, men who are familiar with all phases of the manufacture of the parts being machined, are stationed throughout the plant in all machine shops, and it is their duty to inspect the first piece of any machined part after each separate machining operation. A record of this inspection operation is kept on the operator's job card so that the responsibility for this check can be determined at any time. While this is a costly setup and involves an expansive inspection, it not only assures the manufacturing department that their machining setup is correct, but it also is a big factor in minimizing scrap and maintaining a high grade of quality.

In addition to the floor inspectors, tool inspectors are also stationed in machine shop departments. It is their function to check, at frequent intervals, the gauges and measuring devices of the machine operators and inspectors to eliminate the possibility of using incorrect or worn tools or gauges in the shop or in the inspection department.

Heat-Treat Inspection

A group of inspectors is also stationed in the various heat-treat departments, whose function it is to check heat-treated materials for hardness. For this purpose, banks of hardness testing machines are used. After parts are machined beyond certain operations, it is impossible to re-heat treat them without warping them so out of shape that they will not machine to finished dimensions.

It is also the function of the heat-treat inspection to check samples of case-hardened parts, which are sectioned and the depth of case determined to be within blueprint requirements before the parts are released to the shop.

After parts are finished machined, they are moved to conveniently located central inspection cribs for final inspection by inspectors who are guided by the use of operation sheets and drawings. The operation sheets specify various gauges to be used and the method of inspection. Rolling fixtures are provided for use in checking all gears. Inspectors are not permitted to deviate from the drawing or operation sheets, regardless of what the discrepancies may be. They must refer all such decisions to the foreman. When so directed by the inspection foreman, the inspector routes defective material to salvage using a hold ticket containing complete description of the defect and other necessary data for disposition.

Practically all parts are given complete inspection, except such small parts as nuts, washers, cotterpins, *etc.*, which receive a percentage inspection. This partial inspection usually involves 10% to 15%, and if discrepancies are found, the entire lot is given a full inspection. Parts requiring machining after assembly are inspected 100% in detail, and rerouted to the machine shop, and again inspected as a machining assembly.

Elimination of sharp corners on engine parts is extremely important because of the high stresses to which aviation engine parts are subjected. Inspectors are cautioned to observe this carefully, and to inspect each part for sharp edges, and corners. A mere break edge of a corner is not considered satisfactory, as that creates two sharp corners where only one existed before. It is necessary to radius the edges in order to produce a job that will pass inspection. On highly stressed parts, such as master rods, and crank-

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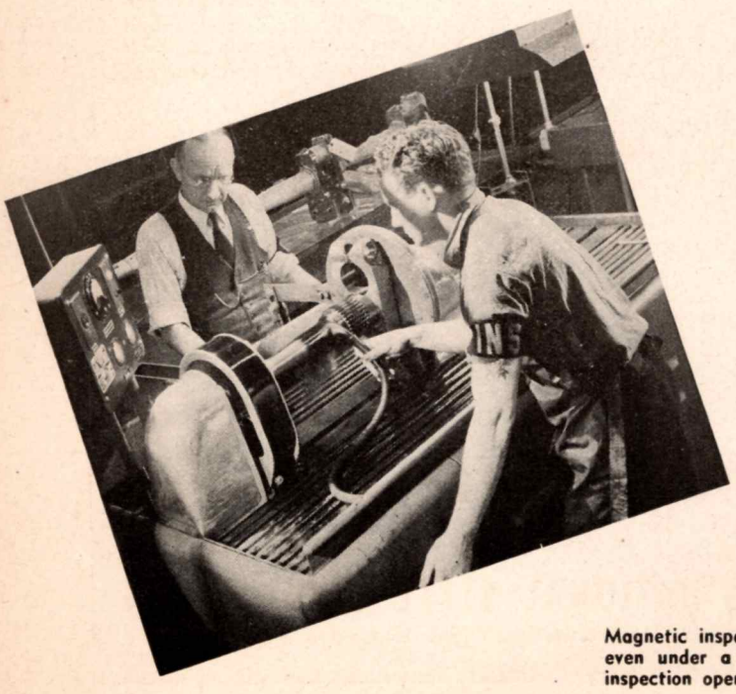

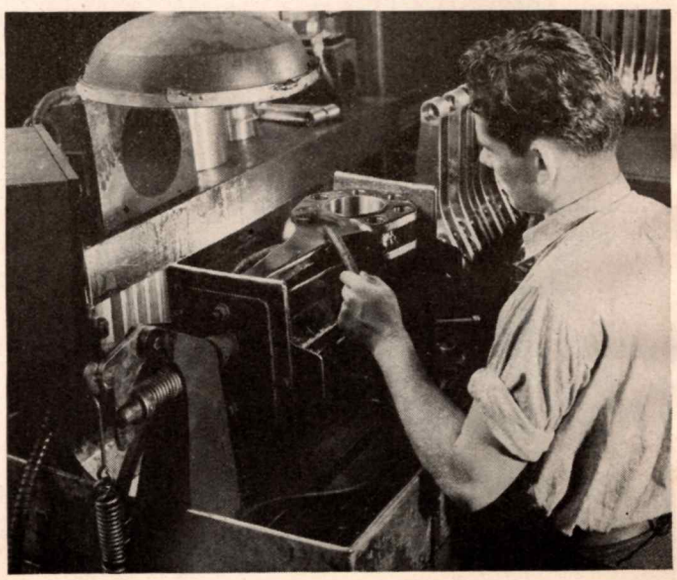

Magnetic inspection of crankshafts to detect flaws so fine as to be invisible even under a powerful magnifying glass. At the right, a magnetic type of inspection operation on a master connecting rod for a Wright Cyclone engine

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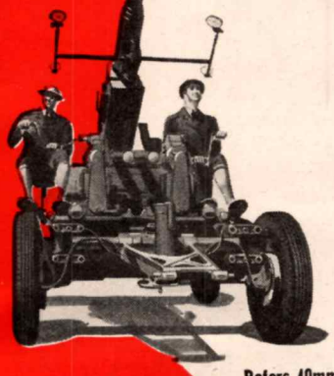
FOR THE AERIAL DEFENSE OF AMERICA . . .

N-A-X

High Tensile

(X9115)



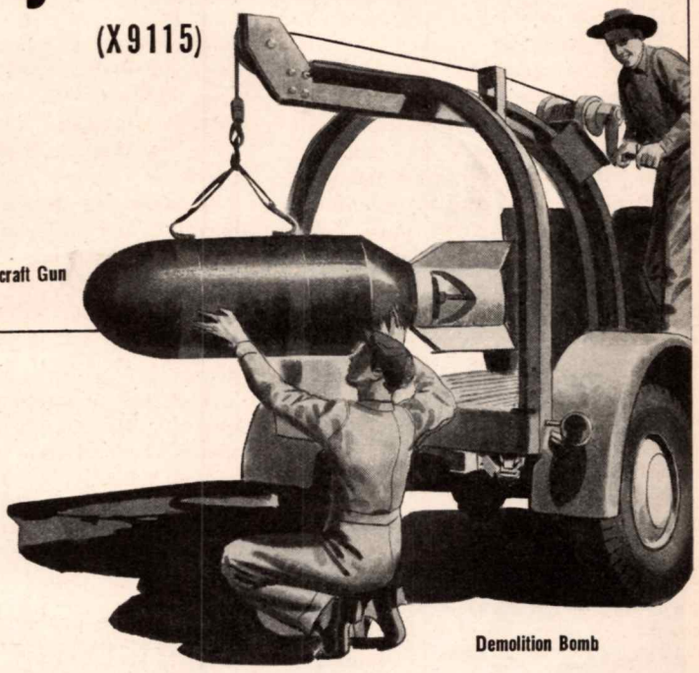
Bofors 40mm Anti-Aircraft Gun

DUCTILITY

ITS INHERENTLY FINER GRAIN MAKES ALL THE DIFFERENCE

STRENGTH

Oxygen Supply Container



Demolition Bomb

is being used in increasing quantities

Because N-A-X HIGH TENSILE is a really superior low alloy steel—one that has unusually high resistance to IMPACT and FATIGUE—it is being used in a multiplicity of defense applications—in the air, on the ground, at sea.

N-A-X HIGH TENSILE has other important properties, too, that permit the fabricator to form parts and products with speed and ease. This low alloy steel works well in all phases of fabrication, and its outstanding ductility and cold forming properties combined with excellent welding characteristics make for low-cost fabrication.

Long before the rush to arm this country was paramount, N-A-X HIGH TENSILE was being used in hundreds of exacting applications. It met the specifications of discriminating manufacturers and users. Quite logically, then, it was natural for fabricators to think *first* of N-A-X HIGH TENSILE. Today, it is being used in ever increasing quantities—and doing an excellent job in every application. N-A-X HIGH TENSILE performs outstandingly in each type of treatment—stamping, hot and cold forming, welding, machining and heat treating.

Would you like to have full information about N-A-X HIGH TENSILE? Call for a Great Lakes engineer today. He will be glad to aid you in the use of this superior low alloy steel—show you how hundreds of others are producing quality products smoothly, quickly, economically. Write, wire or telephone for a Great Lakes engineer today.

LIST OF PRODUCTS

Hot Rolled Strip (down to 1 inch wide) . . . Hot Rolled Strip Sheets (up to 91 inches wide) . . . Spring Steel (carbon and alloy) . . . Merchant Bars . . . Forging Bars . . . Automobile Bumper Sections . . . Bar Mill Sections . . . N-A-X HIGH TENSILE Bars, Shapes, Sheets, Billets . . . Sheet Bars . . . Hot and Cold Rolled Sheets . . . Michigan Metal for Vitreous Enameling . . . Deep Drawing Quality (in all grades, widths up to 91 inches) . . . Stran-Steel Metal Framing for Residential and Commercial Construction.

GREAT LAKES STEEL CORPORATION—DETROIT, MICHIGAN

Sales Offices in Principal Cities

division of NATIONAL STEEL CORPORATION

Executive Offices, Pittsburgh, Pa.

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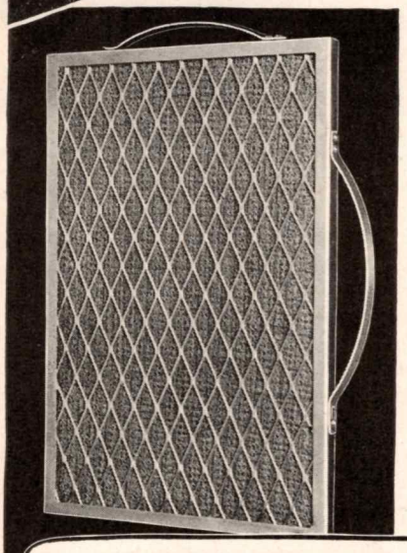
To keep 'em flying!

—as well as to protect them in the making



TYPICAL AAF AIRPLANE ENGINE FILTER

AMERICAN Air Filters and Dust Control equipment have protected the manufacture of airplane engines since 1923—now in 1941 the same proved principle of air cleaning is incorporated in AAF filters for protecting the engines themselves while in flight.

A plane whose engine fails to deliver its maximum horsepower due to dust worn cylinders, is at a decided disadvantage in combat—so army aircraft engineers are today specifying air filters to make sure America's planes keep flying.

The American Air Filter Company in cooperation with aircraft engineers has developed a line of engine filters which meet airplane construction requirements, and specifications of the Army Air Corps. AAF airplane engine filters provide—

(1) Minimum size, weight and thickness.

(2) Highest possible cleaning efficiency.

(3) Minimum rise in resistance with maximum dust accumulation.

For complete information send for our latest technical bulletin.

Send for this FREE *technical report*

Technical Report on air filters for airplane engines No. 306 is available without obligation. This report contains performance charts based upon research conducted with both thin and thick filters using several types of filter media in addition to practical installation data and servicing requirements. Canadian manufacturers will please address their inquiries to Darling Bros., Ltd., Montreal, P. Q.

AAF

AMERICAN AIR FILTER CO., INC., 317 Central Ave., Louisville, Ky.

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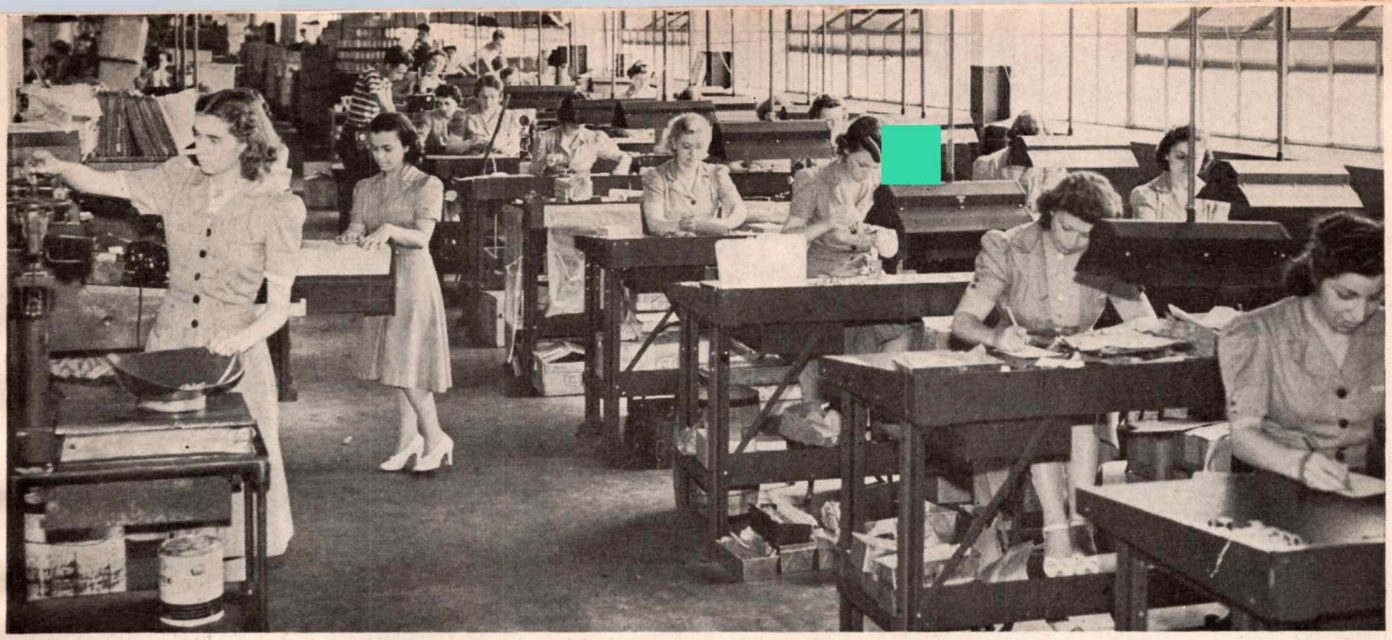


These young women inspect 105,000 engine parts daily at the Wright Plant

(Continued from preceding page)

shafts, generous radii at all corners are insisted upon.

No tool marks are permitted on highly stressed parts or in stressed areas of any part, and in the past samples of desired finishes for certain parts have been established as a guide for inspectors. More recently, surface measuring equipment has provided the means of measuring surface finishes in terms of micro-inches, (one millionth [.000001] part of the U. S. standard linear inch; a unit of length which is convenient and appropriate to many measurements of roughness of "smooth finished" and other similar industrially important surfaces). The engineering department has generally established on many of the parts, on which there are bearing surfaces, the desired micro-inch finish, and the inspectors check for this finish by samples or by surface measuring equipment if necessary.

After material is inspected and ready for delivery to finished stores, the inspector fills out a transfer ticket which includes such information as quantity, part number, and part name. This ticket must be signed by the inspector who performed the inspection, and since no material is accepted in finished stores unless it is accompanied by a transfer ticket properly filled out, this assures that only properly inspected material enters finished stores.

Each inspected part, where it is possible, is marked with the individual inspector's number, either by acid etch rubber stamps, or by steel stamping. However, the use of steel stamping is minimized because of the danger of starting an initial failure in a highly stressed part. In this connection it may be well to mention that the steel stamps are designed with rounded edges on the working part so as to eliminate, as much as possible, this danger.

Before delivery to finished stores, parts are, wherever possible, also identified with the engineering change letter, so that the exact condition of the part in relation to engineering design is known.

Parts are degreased and oiled and protected against corrosion while in stores and, in most instances, are packed in individual cardboard containers before delivery to finished stores.

Salvage Inspection

Parts deviating from blueprint or specification requirements are forwarded to the salvage department for disposition. This department employs inspectors with long experience in the shop. These men, who also are familiar with the functioning of the parts, go over the material carefully, checking the defects reported on the hold ticket to see that the notations thereon are correct, and segregating the material into groups—rejected, to be corrected, or passable. The material is then submitted to the salvage committee for final decision.

Besides the functional detail of deciding the status of material not strictly in accordance with blueprint requirements, the salvage committee takes preventive measures against the recurrence of serious mistakes, by contacting the head of the department responsible for the error and getting assurance from the parties involved that proper corrective measures have been taken to prevent a repetition of the mistake.

Another function of the salvage department is to act as contact to the purchasing department, and through them contact the vendors supplying materials which do not meet Wright's standards. Such questionable material is held in salvage until the vendor is notified and has an opportunity either to come in and look it over, or give us a release to ship it back to him.

Trouble Reports

In spite of the care and supervision devoted to the inspection setup, parts which will not assemble as they should are occasionally passed through to finished stores and from there to the assembly floor, and also to the customers.

Such troubles are reported directly to the quality manager in writing by the chief inspector of the assembly department, and also by the supervising inspectors in the shop. It is the function of the quality manager's aide to investigate these troubles, contact the inspectors and machine shop foremen or engineers involved and see that corrective action to remove such materials from stock is taken, and either have them corrected, if possible, or scrapped if it is found that the part is not usable. If the fault is a vendor's, he is informed of the trouble and requested to correct it.

As each inspector is assigned an individual stamp to identify the parts he inspects, it is possible at all times to contact the inspector responsible for passing defective material.

The trouble report is then held in an open file until the troubles have been corrected, at which time a reply to the report is made by the quality manager. Service division unsatisfactory reports from customers are handled in the same manner. These records are analyzed in an effort to improve the efficiency of the quality department and to help maintain the high standard of quality of the product.

Magnetic Inspection

Inspection of parts for material defects has been a difficult operation for an inspector to perform satisfactorily. The only methods known until a few years ago for detecting such defects were magnifying lenses and various types of etching operations. These were unsatisfactory, inasmuch as they were not positive. The difficulty in this type of inspection has been reduced and simplified by the magnetic method of inspection which, parenthetically, is not for the purpose of rejecting parts that show indications of defects, but to eliminate parts that may cause failure of the engine.

In the Wright plant today practically

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

all of the steel parts are magnetic inspected for defects. On highly stressed parts, it is necessary to keep accurate records of various heats of steel to assist the steel and forging manufacturers in their effort to improve the grade of material supplied, and also to improve forging methods to reduce rejections from material defects. Rejected parts are lacquered to preserve the indications, and returned to the vendor for investigation in their laboratory.

The magnetic inspection is conducted by specially trained inspectors who do the routine work connected with this type of inspection. When parts show indications that are outside of the normal to be found on any particular part, these parts are submitted to the supervising inspector and he, together with a laboratory representative assigned to this particular duty, decide upon the disposition of the parts in question.

Assembly Inspection

Parts are delivered to finished stores where they are placed in bins or racks and held until orders are received from the materials control department. The parts are taken from their location and placed on segregation racks, and then delivered to the minor assembly benches in the assembly department for assembly, also for fitting to get proper clearance as required by specifications. The sub or minor assemblies when completed are inspected, and then passed on to the green or production line for engine build-up.

The engine is then built up on the green or production line, each step being supervised by the inspection department. The engine is now ready for production test and is delivered to the test department. Here it is mounted on a test stand. It is run in for a period of time to warm it up and then put through its paces on test as required by the test specifications. These tests are witnessed by the inspection department to see that all specifications are met.

After this test the engine is removed from the stand and delivered to the teardown department where it is disassembled sufficiently to permit visual inspection of running surfaces. The parts are gone over by the inspection department personnel, and if every part is found to be satisfactory the engine is passed to the final assembly line.

If, however, it is necessary to replace a major part because of unsatisfactory performance, then the engine is rebuilt for penalty test. This consists of running the engine and such additional testing as is considered necessary by the chief inspector to prove the replaced parts. If these parts are found to be satisfactory, the engine is released to final assembly.

Final Assembly

During the final assembly, each of the 72 steps is supervised by the inspector. After the engine is assembled for final test and the last check made by the inspector, the engine is weighed. This is also checked by the inspector.

The engine is then delivered to the test department for final test.

During the final test the following readings are made and recorded on a log sheet: time of day, percent of rate of speed, mixture control position, manifold pressure, absolute manifold pressure, revolutions per minute, observed horsepower, oil consumption, oil pressure, oil in temperature, oil out temperature, oil press. low speed clutch, oil press. high speed clutch, oil press. hydro control, lb fuel per hp hr, fuel pressure, fuel temperature, fuel flow, carburetor air temp., tunnel air temp., barometer readings, cylinder head temp., front section temp., check idle speed, check acceleration, check single magneto, and performance.

These readings are taken by the tester and checked by an inspector. If the test is satisfactory, the engine is shut down and checked for oil leaks by inspection.

Test specifications for each type of engine are promulgated by the engineering department. These specifications state under what conditions the engines are to be tested, and the inspection department is responsible for seeing that these specications are strictly adhered to during the performance of the test.

Packing Inspection

If the engine is satisfactory, it is again started and run from 15 to 30 min on gasoline which does not contain tetraethyl lead; this is done to prevent corrosion setting up in cylinder bores and valves.

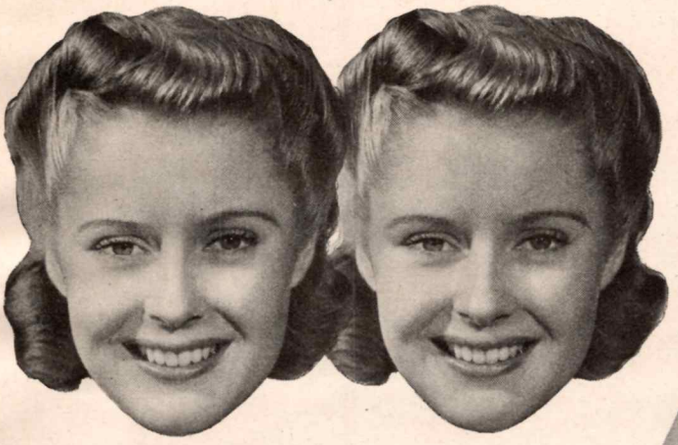
After this run, the engine is removed from the stand and delivered to the packing room where it is again checked as noted on operation sheets in the inspection forms. The inspector has 56 operations to check, plus checking the engine for damage or mutilation which may have occurred on test or in building. The engine is then placed in a shipping box and delivered to the shipping department.

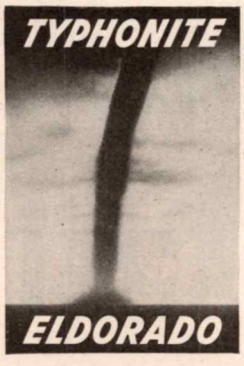
The final inspection operation is to see that the cover of the packing box is properly put on. The box is then sealed with a lead seal so that it is impossible to open it without breaking the seal.

A young woman inspects exhaust valves on a Rockwell Superficial Hardness Tester at the Cincinnati division. At the right, testing push rod ball ends for the Wright Cyclone and Whirlwind engines in production at Paterson, N. J.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

Want to see *two* sets of *identical* twins?





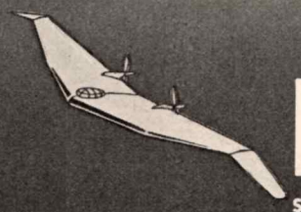
When Dixon says it's an HB, you can depend on its being just that. Two HB's are identical twins. The same is true of any given degree throughout the range of 17 degrees. Such uniformly accurate grading is made possible by *Typhonite*—whose particles are of minutely even, controlled size—the size found best for lead making. *Typhonite*, product of an exclusive Dixon process, is responsible for the smoothness of *Typhonite* Eldorado leads as well as their opaque lines. Your dealer will supply you with Dixon's *Typhonite* Eldorado.

PENCIL SALES DEPARTMENT 39-J11, JOSEPH DIXON CRUCIBLE COMPANY, JERSEY CITY, N. J.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

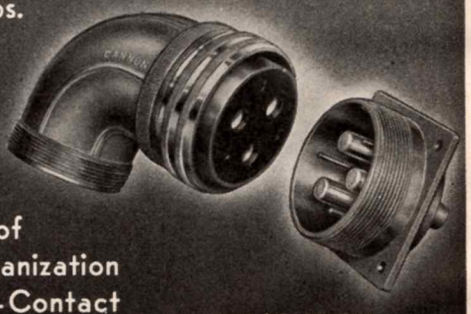
SKY MASTERY

Northrop Flying Wing



REVOLUTIONIZING conventional concepts of aerodynamics, Northrop's "Flying Wing" promises to place super-speed, long-range, fighting power in the eager hands of the United States Army Air Corps. Interest in the strange, tailless craft bearing a startling resemblance to a prehistoric bird of prey is at white heat, following release of photographs of the flying model secretly tested in California skyways under the watchful eyes of the Army Air Corps.

Serving Northrop, as it does the great majority of America's major aircraft factories, the Cannon Organization speeds the task of building CANNON Multiple-Contact Electrical Cable Connectors which play a vital role in the gigantic effort to insure victory for the forces of freedom.



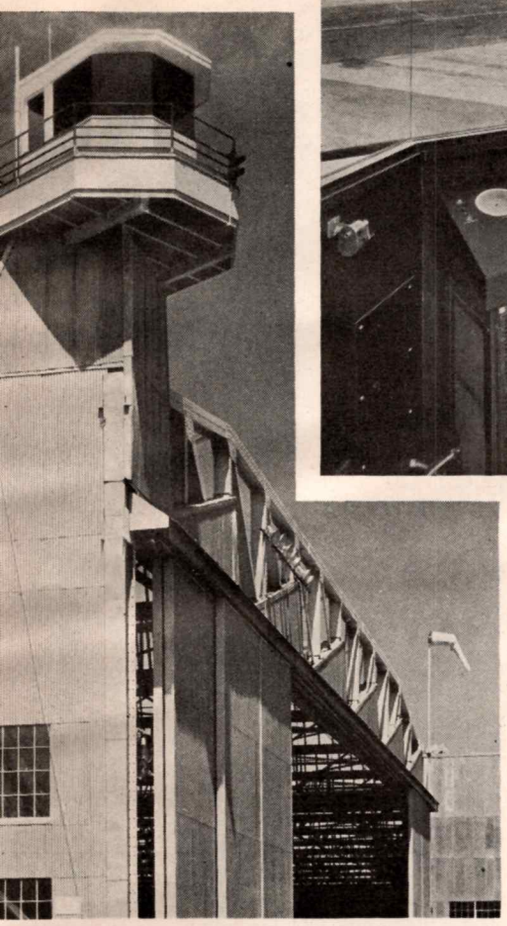
Typical CANNON AN9534 Plug Assembly designed for 110 V service.

CANNON PLUGS

CANNON ELECTRIC DEVELOPMENT CO. 3209 HUMBOLDT ST., LOS ANGELES, CALIF.

Eastern Sales Office: 220 Fifth Ave., New York City, N. Y. • Chicago Agency: Kelburn Engineering Co., 600 W. Jackson Blvd.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



Exterior and interior views of the Vultee control tower atop the hangar at Vultee Field; the operator in this tower controls and directs, by radio, all incoming and outgoing air traffic at Vultee's Airport

FLIGHT TEST PROCEDURE FOR VULTEE TRAINERS

L. H. COOPER

Flight Operations Superintendent
Vultee Field Division, Vultee Aircraft, Inc.

● The following flight test procedure is now being used for the Vultee *Valiant* basic trainer which is being manufactured at a steadily accelerating tempo at Vultee Field, Calif., by Vultee Aircraft, Inc., for the U. S. Army Air Corps. Flight tests for the Vultee *Vanguard* P-66, also currently being manufactured, are necessarily even more detailed because of the more complicated construction of combat aircraft; but the routine procedure, in general, is somewhat similar.

Flight procedure is the responsibility of the Flight Operations Department, which not only runs the Vultee Field Airport and control tower but also tests every airplane that this huge 6700-employee factory makes.

The field itself has two asphaltic-concrete runways: N-S 3872′ × 100′ and E-W 2800′ × 80′. These give ample dimensions for the type of equipment now in production at this plant.

Not only is Vultee the first aircraft factory in America to speed up the mass production of military airplanes by installing a completely mechanized, constant-flow, continually moving, powered overhead conveyor assembly line (see AERO DIGEST, July 1941), but it also is the only aircraft company in the United States which owns and operates a control tower exclusively for its use.

This tower serves two purposes: it controls aerial traffic; and it functions as a monitoring station for setting aircraft radio frequencies. The tower's equipment consists of three receivers monitoring frequencies 3105, 4495 and 4342.5, with two stand-by receivers. The transmitter is a 50-watt RCA which transmits on the Air Corps frequency 4342.5. Other equipment includes Kollsman altimeter, a master oscillator for setting radio frequencies, and Friez weather equipment.

This control tower averages approximately 400 radio contacts a day, and controls 120 landings and take-offs. While this total may seem small in comparison with those of some of the major air terminals, it nevertheless necessitates appreciably more observation as about 1 out of every 3 of the flight operations are initial flight tests.

When the airplane rolls off the final assembly line it first goes to Flight Service where its tanks are flushed. The port fuel tank is then filled to capacity, and the starboard tank, which carries the reserve fuel supply, gets 25 gal. The oil tank is filled with 5 gal of run-up oil.

The engine is then run 30 min at 1100 rpm, except for the last 30 sec when it is operated at full throttle. During this period the fuel selector valve is switched to the starboard tank to ascertain that the standpipe provides the necessary 17-gal fuel reserve. The oil is then drained and replaced with a fresh supply.

Next, the plane is taken to the compass rose, where its compasses are "swung." This is done by a master compass which is mounted on a contour board fitted to the right wing. The compasses are swung both with radio on and with radio off.

Upon completion of the compass swinging, the plane goes to the flight line again where the pre-flight service crews set all pressures, check the entire plane, and turn it over for company preflight inspection. As sooon as the company inspector clears the craft, it goes to Air Corps inspection.

Flight Office Control

But before going further, let's first inspect the Flight Office itself where the operations are conducted under an efficient and simple system.

The airplane's number is placed on a flight board in two places; on top, for company flight; and on the bottom, for Air Corps flight. Ordinary cup hooks are placed under each number on which hangs a metal plate, painted red on one side and blue on the other. When a plane comes from the assembly line into

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

In front of the flight operations office, flight service men check over "Valiant" basic trainers after they come off the Vultee assembly line

Flight Service, a corresponding numbered red plate is hung up, remaining there until the plane is ready for its initial test flight. When the service crew has completed its work, and the plane has had both company and Air Corps inspection, the tag is turned over with the blue side out. This indicates that the airplane is ready for company test flight.

On the same flight board are smaller plates, colored in the same manner, but these have a pilot's name on them. For example, when plane No. 1224 is ready for flight, the pilot assigned to this airplane puts his name-plate over the airplane's plate, blue side out, indicating that he is going to fly that airplane. If the plane is grounded for minor adjustments, the name-plate is turned red side out.

As soon as the plane has been test-flown by a company pilot, the pilot's recommendations on adjustments attended to and the job pronounced satisfactory, the red plate of the airplane is hung below on the Army flight board indicating that there is an item to be taken care of—in this case, to change the radio over to 4495 kc Army frequency. When this change has been made, the plate is turned to the blue side to indicate that the plane is ready for the Air Corps final acceptance flight.

If the Air Corps finds that airplane acceptable, the plane's number is transferred from the flight board to the acceptance board, together with the date of its acceptance. It is then given its fly-away service, which includes cleaning all screens and a visual inspection by both company and Air Corps. After this the airplane is placarded, transferring its ownership from Vultee to the Army Air Corps.

In order to maintain at all times an accurate double check upon every plane received from the final assembly line, a master board is kept in the Flight Supervisor's office; this board is checked and revised each morning at 7:30.

The First Test Hop

The new airplane, after going through the complete Flight Service operations and all ground inspections, both company and Air Corps, must be flown both in an initial test hop and in a subsequent flight to test the corrections made by the ground crews.

Vultee's flight test procedure is divided into three main divisions: (1) ground check and run-up previous to take-off; (2) take-off and climb; and (3) check at cruising altitude.

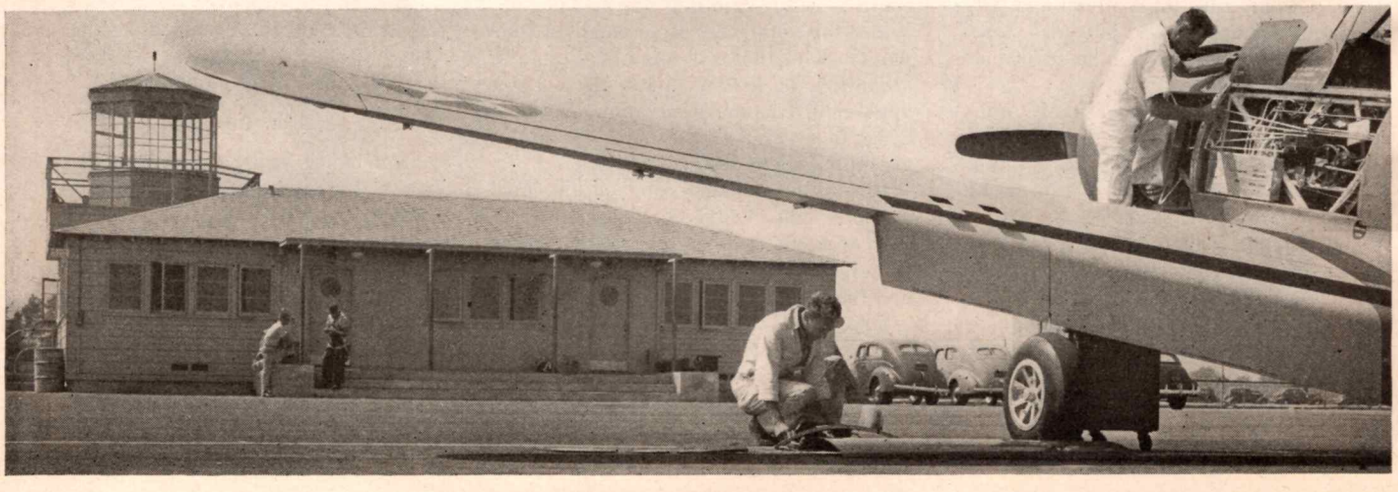
In ground checking, the pilot checks with the crew chief of the plane to be flown on its first test flight, and starts the engine. During the warm-up, the items checked are:

- Contents of left and right fuel tanks, and valve position
- Operation of primer
- Instrument (engine) indications
- Adjustment of flight instrument power sources
- Fuel warning light operation
- Free action of all control surfaces
- Tabs and their positioning
- Propeller control in low pitch
- Rudder pedal and brake adjustments
- Control lock
- Safety fastening on cockpit equipment
- Canopy operation and position of canopy emergency exit locks

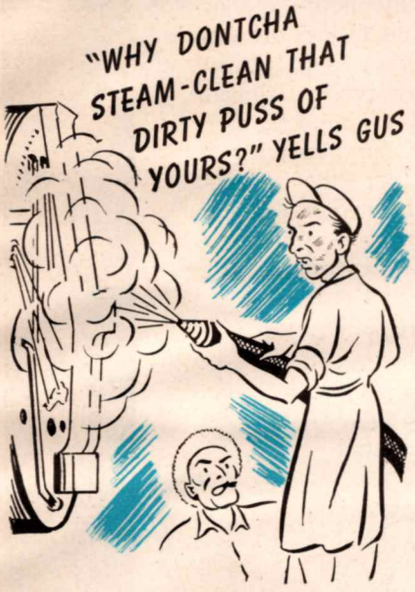
Radio contact is then made with the tower and permission requested to taxi out. Receiving permission, the pilot taxies to the head of the runway designated, meanwhile checking the brake action, and engaging and disengaging of the steerable tailwheel. At the head of

(Continued on following page)

Exterior view of the flight operations office at Vultee Field. Members of flight service are working on a "Valiant" basic trainer in the foreground



BALL BEARING DO'S AND DON'TS FOR MECHANICS



"If yer gonna turn th' steam on everything, turn some on yer mug," shouts Gus at Ab Plowhandle, our new mechanic from the sticks. Ab is washing down a ship's firewall, and steaming all the grease out of the control bearings. "That ain't no threshing machine you're workin' on," Gus reminds him . . .

GUS SAYS "DON'T!"

DON'T return new ball bearings to stock without putting them back in boxes or wrapping carefully . . .

DON'T do a welding job next to a grease-packed ball bearing; your grease won't last . . .

DON'T press a ball bearing into a housing by pressing or hammering on the inner ring.

Why Bearings Fail

Fourth of a series of instruction sheets published by The Fafnir Bearing Company, based on its experience with the leaders of U. S. aviation.

IF INSTALLED cleanly and properly, ball bearings will outwear most related parts. For example, ball bearings in control pulleys often outwear the pulley bodies.

STUDYING bearings that have failed, and finding out why, always brings us to one fact: Most bearing failures can be prevented by more care in bearing installations.

FIRST CAUSE of bearing failure is letting dirt get in, or damaging bearing while pressing or staking it.

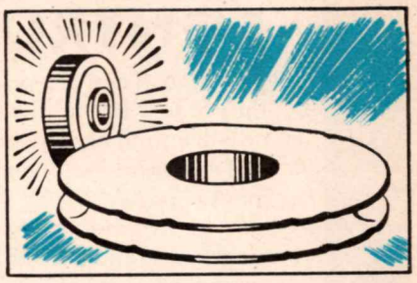
SECOND COMMON cause of bearing failure is careless wash-down of parts, permitting wash solvent or steam to "steal" lubricant from engine control bearings.

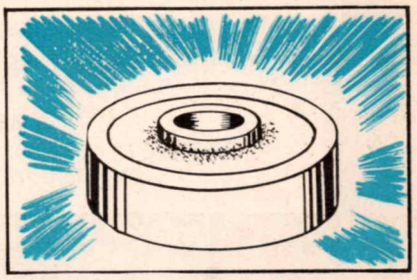
MIS-ALIGNMENT of rigid-type bearings at their installation kills many bearings young.

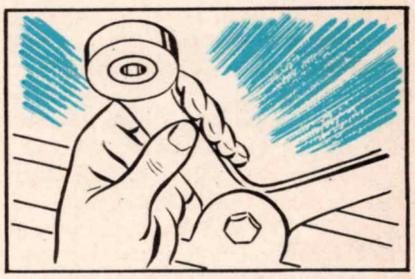
OTHERS FAIL because of entrance of moisture, or high temperatures.

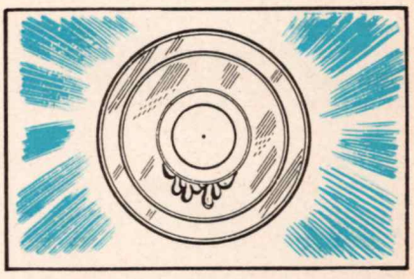
FRICTION OXIDATION or "false brinnelling", caused by undue vibration, can wear balls and races of a bearing that is clean and well lubricated.

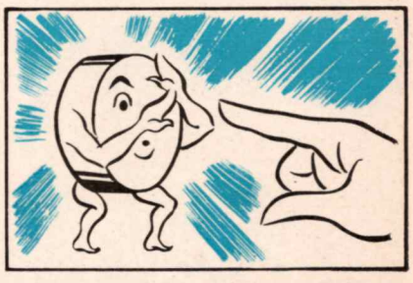
DON'T BLAME the bearing if you have an application that causes continual trouble. Let the Fafnir Aircraft Engineers check it and find the trouble. The Fafnir Bearing Co., Aircraft Div., New Britain, Conn.











DELICATE AS A WATCH
— TILL YOU INSTALL THEM

TOUGH AS A DIAMOND
— AFTERWARD

FAFNIR
Ball Bearings
FOR AIRCRAFT ENGINES AND CONTROLS

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

Specify HAZARD AIRCRAFT CONTROLS

When you specify Hazard you specify safety—in control equipment. Hazard controls and fittings are dependable. They are made by the people whose entire business doctrine is contained in the phrase "In Business for Your Safety." Available in either 18/8 stainless steel or in tinned or galvanized carbon steel. *All* Hazard aircraft cable is preformed. This is important for two reasons. First: it endows the cable with high resistance to fatigue. That makes it last longer. Second: Being preformed, you can use Hazard TRU-LOC Fittings—the swaged-on type that are attached to the cables without heat or solder. Hazard TRU-LOC Fittings are the most efficient cable terminals known. Every item of Hazard equipment is made in accordance with the latest Army and Navy specifications. For certain dependability—for safety of control operation—specify Hazard.

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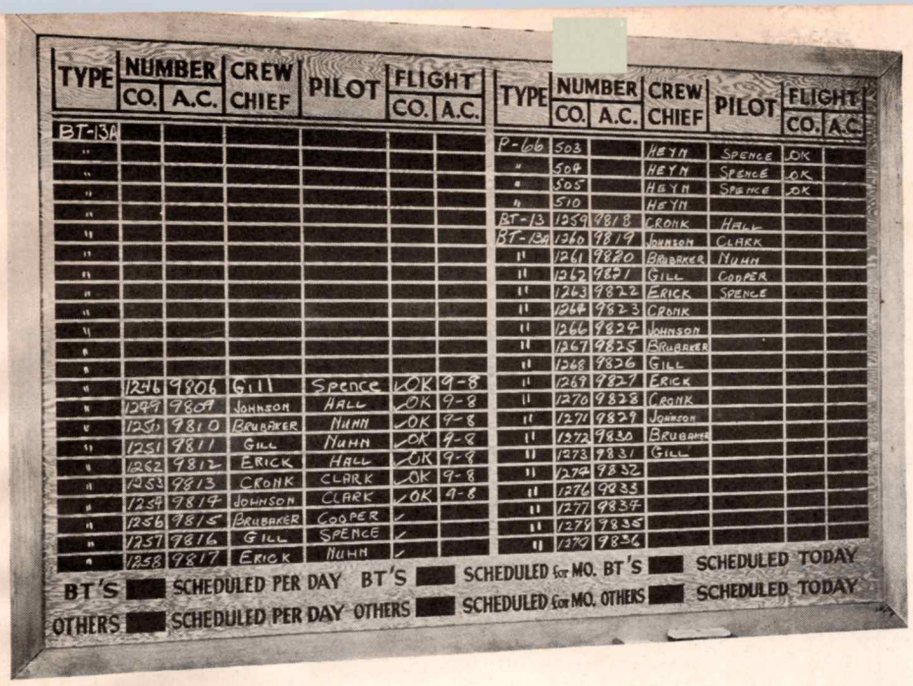
630 Third St., San Francisco • 6-235 General Motors Building, Detroit

HAZARD AIRCRAFT CONTROLS

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



Master board, showing the status of all airplanes in service and flight operations

(Continued from preceding page)

the runway, he lowers the wing flaps to the 30° takeoff position. He then rechecks the fuel valve, engine controls, propeller control, tab setting positions, and runs up the engine for a final check before takeoff.

Takeoff and Cruising Procedure

During the takeoff, the test pilot notes instrument indications and checks wheel balance. If either or both wheels are not properly balanced the intensity of the resulting roughness is noted. When the climb has leveled-off, flight and engine instrument readings are taken and their operation checked.

Then tested for normal operation are fuel valve positions, carburetor hot air, oil temperature control, electric panel switches, and engine controls.

Also, during the course of the climb, a radio check for both transmission and reception is made with the tower operator. Upon satisfactory completion of this check, the band switch is changed to radio range frequencies and one of the local range stations is tuned in. The range filter and inter-cockpit communication switches are checked on the range signal. This having been done, the tower is tuned in again and a listening watch maintained on the Vultee frequency throughout the remainder of the flight.

On reaching cruising altitude, the selection of which depends upon weather conditions, and the area over which the plane is being flown, the pilot raises the wing flaps if they were used for the climb, changes the propeller pitch, and stabilizes the level flight attitude at cruising rpm. He checks the effect of temporarily leaning the mixture, and notes the resultant position of the mixture control.

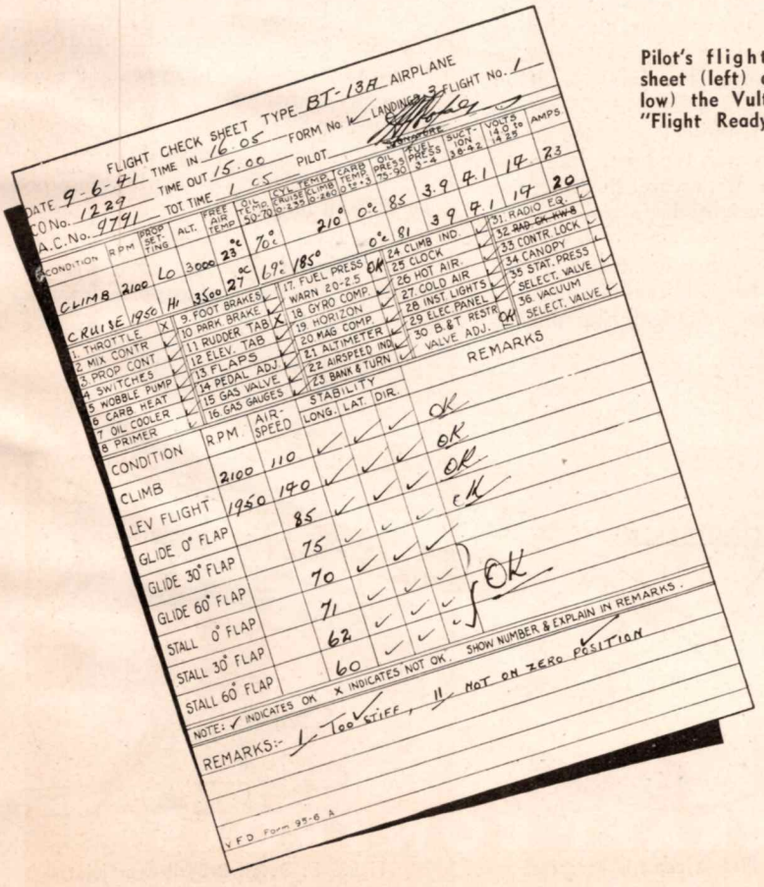
Next he turns the fuel valve to the off position, runs the carburetor dry, and notes the amount of indicated pressure at which the fuel warning light comes on during the loss of fuel pressure. When the engine stops firing, the pilot turns the fuel selector valve onto a tank again, and partially closes the throttle to prevent backfiring during the re-starting.

Left and right ignition switch positions are tested, and the drop in engine rpm checked. After engine temperatures have dropped to cruising indications, flight data and instrument indications are taken.

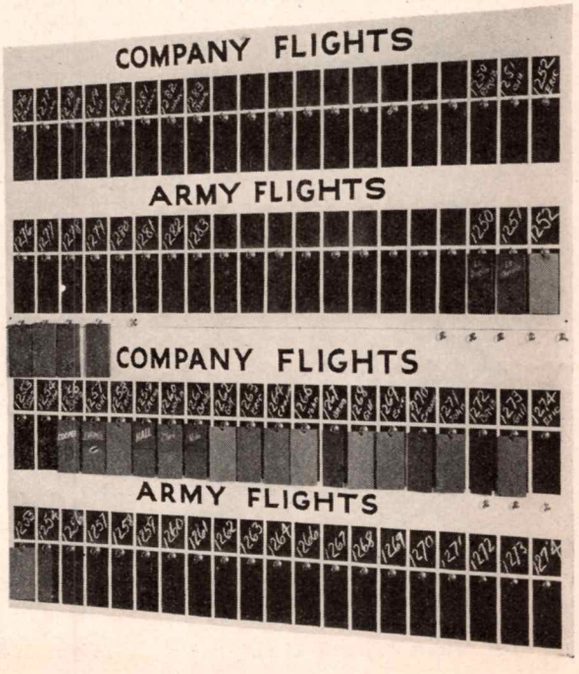
Directional, longitudinal, and lateral stability of the aircraft are determined; and the amount of correction on tabs for wing heaviness, if this condition exists, is noted. Flight controls and tabs are checked in extreme positions, and binding or abnormal stiffness is noted.

Power-off Stalls

Three power-off stalls are made with the elevator tab set in full tail-heavy position. These stalls are executed using 0°, 30° and 60° flap positions, with wing flap positions noted and airspeed at which the first warning buffeting of the stall starts. Throughout the stalled condition, stability and control effect are checked. *(Continued on page 198)*


FLIGHT CHECK SHEET TYPE BT-13A AIRPLANE
DATE 9-6-41 TIME IN 16 05 FORM No. 1 LANDINGS 3 FLIGHT No. 1
C.O. No. 1229 TIME OUT 15 00 PILOT
A.C. No. 9791 TOT TIME 1 05
CONDITION RPM PROP SET. TING ALT. FREE AIR TEMP OIL TEMP CYL. HEAD TEMP CARB TEMP OIL PRESS PRESS IGNITION VOLTS AMPS
CLIMB 2100 60 3000 23°C 70% 210° 0°C 85 3.9 41 19 23
CRUISE 1950 H 3500 27°C 69% 185° 0°C 81 3.9 41 19 20
1 THROTTLE X
2 MIX CONTR
3 PROP CONT
4 SWITCHES
5 WOBBLE PUMP
6 CARB HEAT
7 OIL COOLER
8 PRIMER
9 FOOT BRAKES
10 PARK BRAKE
11 RUDDER TAB
12 ELEV. TAB
13 FLAPS
14 PEDAL ADJ
15 GAS VALVE
16 GAS GAUGES
17 FUEL PRESS OK
WARN 20-2.5
18 GYRO COMP
19 HORIZON
20 MAG COMP
21 ALTIMETER
22 AIRSPEED IND
23 BANK & TURN
24 CLIMB IND
25 CLOCK
26 HOT AIR
27 COLD AIR
28 INST LIGHTS
29 ELEC PANEL
30 B&T RESTR OK
VALVE ADJ.
31 RADIO E.Q.
32 RAD OK-NW-8
33 CONTR LOCK
34 CANOPY
35 STAT. PRESS
SELECT. VALVE
36 VACUUM
SELECT. VALVE
CONDITION RPM AIR-SPEED STABILITY LONG. LAT. DIR. REMARKS
CLIMB 2100 110 OK
LEV FLIGHT 1950 140 OK
GLIDE 0° FLAP 85 OK
GLIDE 30° FLAP 75
GLIDE 60° FLAP 70 OK
STALL 0° FLAP 71
STALL 30° FLAP 62
STALL 60° FLAP 60
NOTE: ✓ INDICATES OK X INDICATES NOT OK SHOW NUMBER & EXPLAIN IN REMARKS.
REMARKS: 1 Too STIFF, 11 NOT ON ZERO POSITION
V F D Form 95-6 A

Pilot's flight check sheet (left) and (below) the Vultee Field "Flight Ready" board



See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

DETAIL DESIGN OF WOODEN WINGS

H. R. FOOTTIT
Ass't Chief Engineer
Ryan School of Aeronautics

● For some years now the British military pilot has obtained his preliminary training on a variety of wood trainers before graduating to the *Spitfire* class. In this country, however, we have persistently pursued the design of the metal airplane and have shipped large quantities of spruce to Europe to be milled down into first-class military planes. Only one component of even our commercial airplanes, the wing, has to some extent resisted this popular all-metal trend.

In recent years, though, the use of the wood wing has increased, aided somewhat by that mystical term "plastic." Basically it is still wood, but the use of phenolic-glue joints and phenolic protective coatings, sprayed on or baked into it, have helped eliminate three of the biggest bugbears of wood wing construction—(1) shrinkage, with its attendant warping and cracking, due to the wood drying out; (2) deterioration, due to moisture absorption; and (3) inability of non-phenolic glues to resist moisture, mold and fungi growth.

The old method of coating-on varnish was inadequate to cope with these destructive elements particularly in humid, warm, tropical conditions. However, with careful design the effects of shrinkage, rot and water absorption can be equated to a minimum. In general, airplane woods have a normal moisture content of 12% of their dry weight, though this may drop safely as low as 10%. This drying out process actually boosts the strength of the wood at the expense of an increase in brittleness that lessens its resistance to shock loads.

Woods most commonly used in wing construction are spruce and mahogany faced three-ply. In the past, while we have religiously demanded mahogany plywood, European aircraft manufacturers have consistently favored the heavier and stronger birch ply. The main reason for this difference of opinion is the difficulty of gluing birch to spruce. Mahogany can be glued with a minimum of precautionary measures while a birch-spruce joint requires a more careful gluing technique.

Designing Efficient Wing Ribs

To transmit the air loads to the spars in all-wood wing construction ribs of plywood and spruce are used. Since three-ply is heavier than spruce, the plywood must be used judiciously in the design of an efficient rib. The lightest rib, on a strength/weight basis, is the spruce truss type with plywood gusseted joints. Next is the ply web type with its spruce web stiffeners. With careful rib design this strength/weight distinction will always hold true.

However, it cannot be theorized that the truss type rib is always the best. Its use depends on manufacturing difficulties. For example, shallow truss-type wing tip ribs are awkward to assemble whereas the plywood rib is quickly and easily put together. Similarly a wooden capstrip may crack and refuse to spring down to the correct leading edge contour without steaming. To avoid this special manufacturing process the capstrip can be spliced into a solid spruce nosepiece, contoured to the correct shape, while the remainder of the rib is of the truss or ply web type. Where the contour of the wing thins or bends sharply the webbed or composite rib is the easiest to build.

Whether layouts show truss or webbed construction all ribs, to meet Civil Airworthiness Requirements, must be designed to carry 25% in excess of their ultimate load. Proof of their ability to pack this load is by test; therefore the cheapest and quickest way to design wing ribs is to dispense with the stress analysis, trust to the designer's critical eye and patch up weak points after testing. The two main design conditions, high and medium angle of attack, are critical on different parts of the rib. The high angle condition throws the severest loads on the forward portion while the medium angle test puts the heaviest loads on the center of the rib between spars.

If the wing covering is of fabric and the rib stitching is looped around the rib from top to bottom, all of the test load is applied *via* the bottom capstrip and it can be made heavier than the corresponding upper member. However, on ply and fabric covered wings, where the covering is attached to upper and lower capstrips individually, the upper must account for 75% and the lower 50% of the 125% design load. In this case, capstrips should be designed with these proportions in mind.

Truss type ribs can be drawn up using either Warren or Pratt truss arrangements, depending on clearance for drag

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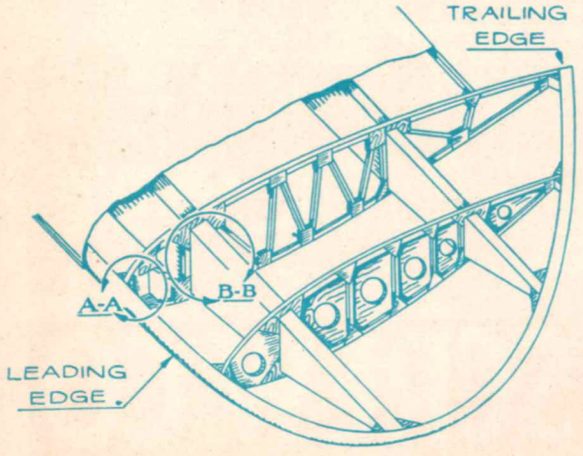

Figure 1: Details of wing tip

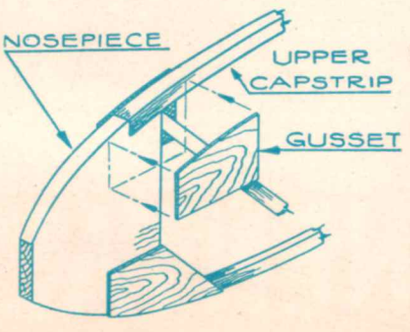

Figure 2: Detail A-A capstrip nosepiece splice

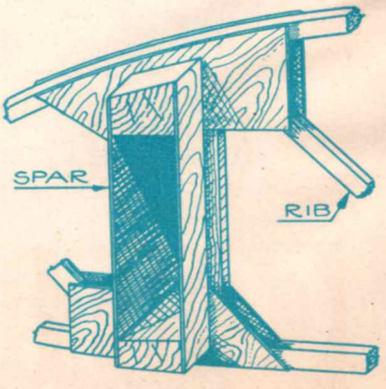

Figure 3: Detail B-B rib-spar joint

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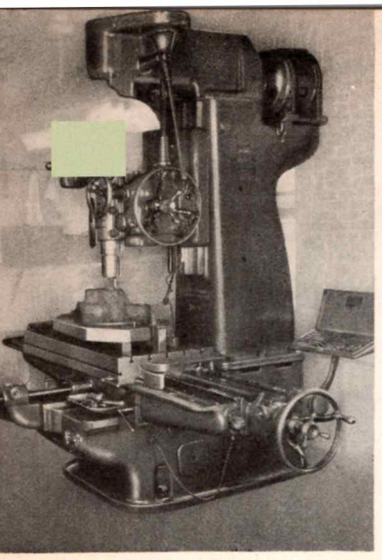
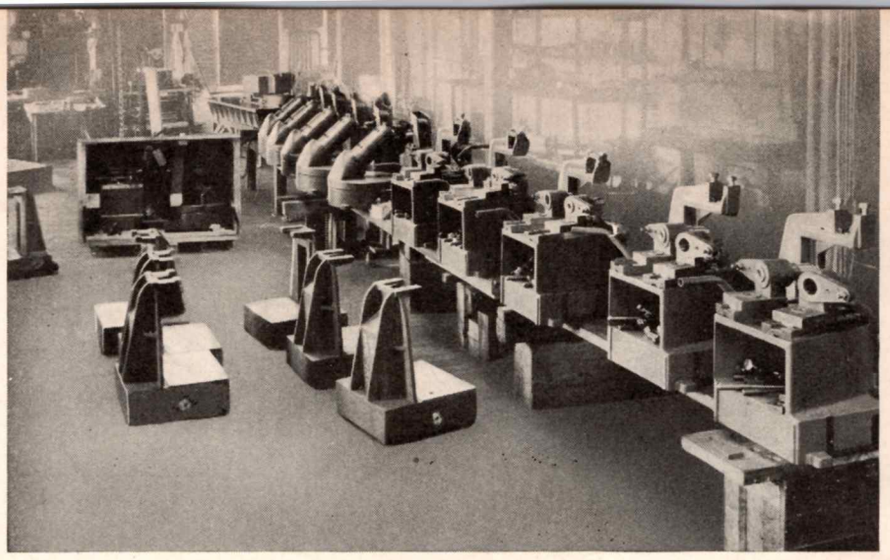
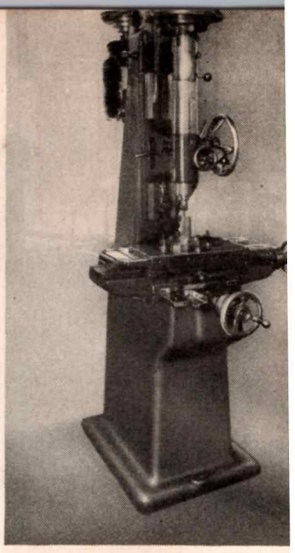
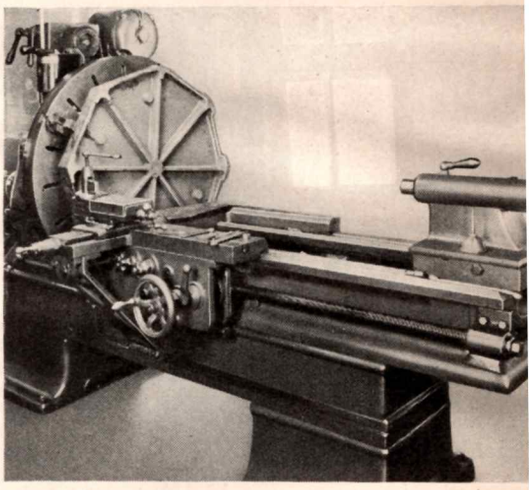






Fixtures for cylinders for the Wright Aeronautical Corporation plants in Paterson, N. J., and Cincinnati, Ohio.



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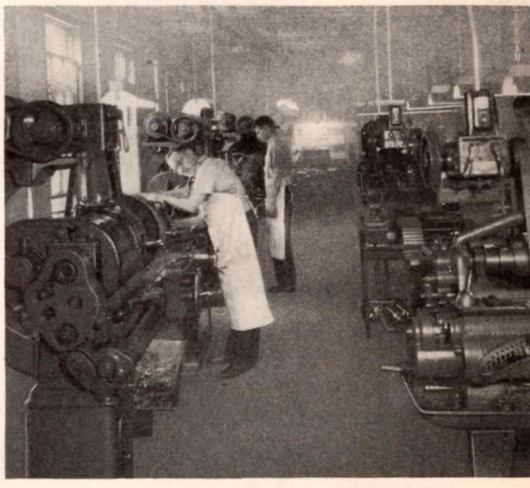
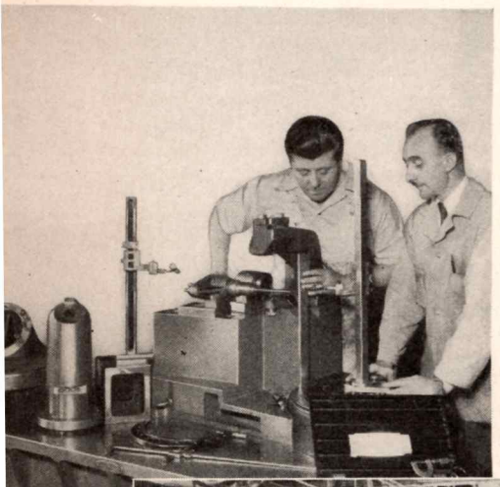


Final inspection on finished gauges and fixtures.



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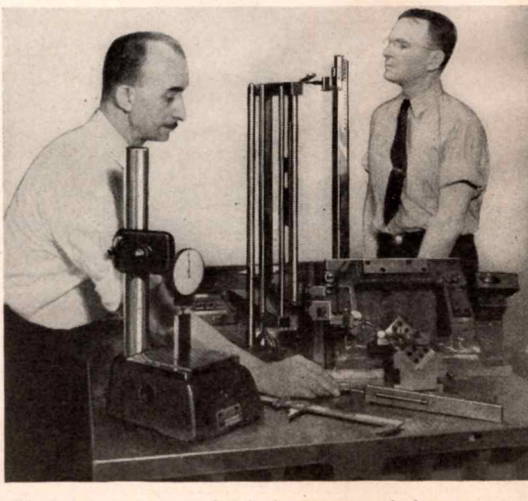


Final inspection on finished gauges and fixtures.

(Continued from preceding page)
wires and control cables, without being penalized for weight. The grain of all members should run lengthwise and diagonal web members adjacent to spars should butt against the upper capstrip-spar joint in compression since compression members are easier to hold at these joints. In general a slight weight saving can be attained by making the web members a little smaller than capstrips since they carry mainly tension or compression loads.

Plywood web ribs, though heavier than the truss type, are generally easier to construct. If the capstrip is large enough it should be divided equally on both sides of the web to prevent twisting of the rib under load. For best strength, the face grain of the ply, when lightening holes are incorporated, should run longitudinally. When spotting in these lightening holes in the web on the rib layout it should be remembered that one 4″ diam hole lightens the rib more than two 2″ diam holes.

Lightening Holes

Lightening hole arrangement is critical as far as the strength of the rib is concerned since failure of the web generally occurs around these holes. Furthermore the lightening hole opens up a jagged wound in the ply and leaves ragged edges open to exposure. Shrinkage and swelling stresses, due to change in moisture content of the wood around the holes, have been known to cause failure of the plywood core in service. The remedy for this buckling and rupturing of the web is to place stiffeners close to the cut edge. A small increase in weight by adding extra stiffeners will pay dividends by increasing the strength of the rib in a greater proportion.

Outboard compression ribs can be simply constructed by gluing and bradding spruce battens to the sides of the standard truss or ply web rib. One or two battens per side may be incorporated though if two are used they should be spaced as far apart as the airfoil contour permits to stabilize the spars. In either case, however, battens should butt firmly against both spars to adequately transmit the full compressive load. The root compression rib may also be constructed in this manner though in some cases a tubular steel compression strut, welded to the spar fittings, is preferred. With this arrangement these fittings can be accurately jigged to remain a constant distance apart, despite any shrinking or warping of the wood with age. This method ensures accurate wing-fuselage attachment and easy interchangeability of wings through many years of service.

The joining of plywood to spruce, on either compression or standard ribs, is accomplished with glue used in shear

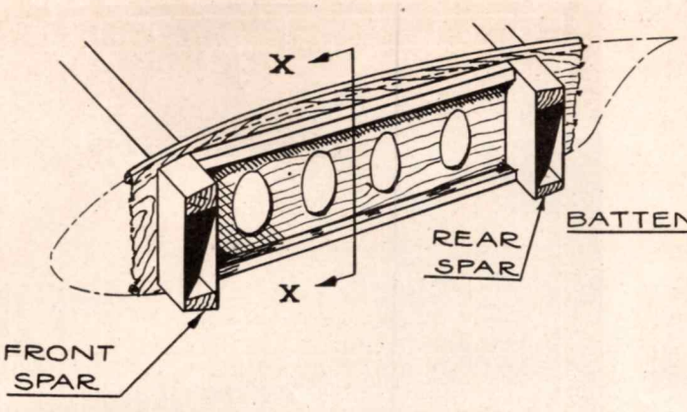


Figure 4: Compression rib

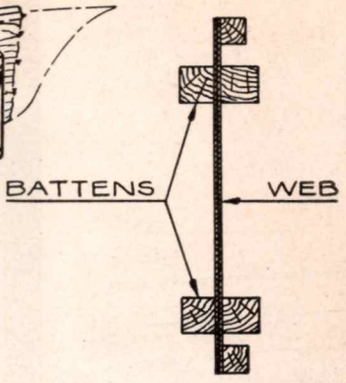


Figure 5: Section X-X through compression rib

and held while setting by clamping, nailing or stapling. The clamping method, though more troublesome, will produce a lighter and stronger rib. Nails (or staples on small ribs only) add weight and crush the material, reducing its cross sectional area and lowering its strength. Drawings should call for cement-coated nails (AN301) or brass brads dipped in glue, varnish or resin to add to their gripping power. In particular the use of nails at spar openings should be avoided since a high concentration of shear on the capstrips takes place at these points and any reduction in the cross sectional area of the spruce capstrip by the insertion of nails will decrease the strength of the rib.

Shear Stress at Spar Openings

To combat the high shear stress at the spar openings the joint gussets at each side can extend over the spar, glued to the side of the capstrip, with their face grain at 45°. Ordinary gussets, used to join truss members, or web stiffeners, to the capstrips, are usually 1/16″ to 3/32″ thick mahogany ply. They should be triangular or rectangular and of the same dimensions, if possible to facilitate manufacture and assembly. Furthermore, they should be designed so their corners fit on the members; overhanging corners add weight but little strength.

Ribs are spaced spanwise along the wing from a maximum of 15″ apart, at a design diving speed of 150 mph or less, to 5″ apart at 325 mph. For preliminary wing layouts the diving speed can be taken as 1.5 times the designed maximum level flight speed. Rib spacings for intermediate diving speeds can be interpolated from the above values, though ribs in the blast of the slipstream should have a 25% closer spacing.

The total weight of all wing ribs is from 10% to 13% of the weight of the finished wing panel. The spars, however, account for 30% to 35%, and therefore more care must be taken with their design. Common types of spars are the solid rectangular and the routed "I" section of spruce, the built-up "I" of laminated spruce, and the box spar with spruce flanges and plywood shear webs. Spar spacing on the conventional two-spar wings is from 10% to 15% chord for the front spar, and 60% to 70% chord for the rear spar. Provided sufficient spar depth can be obtained, the further apart the spars are located the lighter they can be built since spar loadings will have less variation with center of pressure movement.

The ratio of spar height to spar width is important; normally, it should be between 4 and 5. Though the theory of bending would dictate box and "I" beam flanges as wide as possible, actually broad flanges mean unnecessarily large packing blocks, wide spread fittings and long bolts—all of which add weight and provide little additional strength. For built-up "I" sections or box spars a wide, thin flange is not practical if too little gluing area is allowed for the web-flange joint. To obtain the best strength/weight ratio the spars must be a compromise between these conflicting requirements therefore several height-width proportions should be roughly checked to determine the optimum for any particular wing.

Popularity of Box Spars

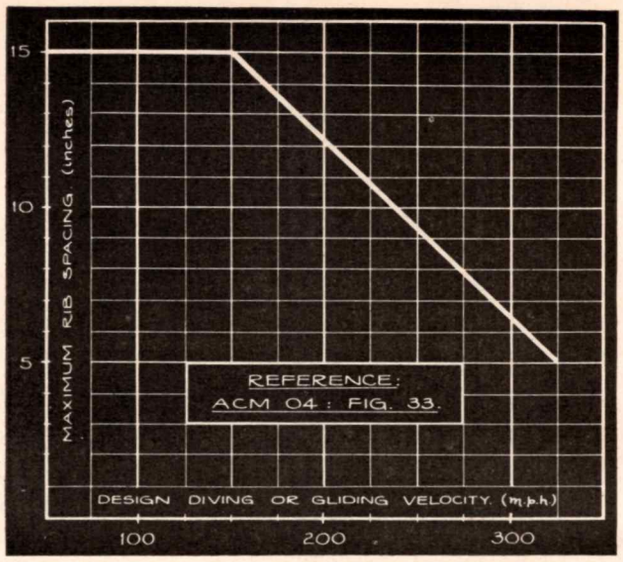
The solid rectangular spar is currently used only for lightly loaded, externally braced airplanes since it is uneconomical from the weight standpoint though simplest from the production angle. Similarly, the routed and built-up "I" sections are generally limited to spars up to 5″ or 6″ deep. Beyond this size the box spar has the advantage of high strength with low weight. With the advent of the cantilever wing with its deep airfoil section at the root the box spar has become most popular.

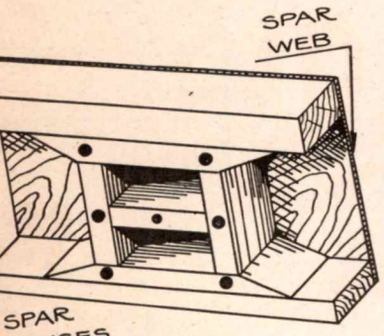
Box spar flanges should have a minimum depth of 1/2″ to allow a strong glue bond between the spruce flange and plywood web. Since the spars must resist heavier up-loads than down-loads a top to bottom flange-depth ratio of approximately 2:1 will yield a saving in flange

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

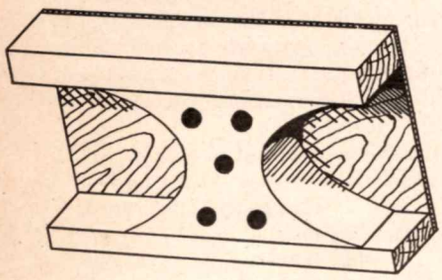
Figure 6: Rib spacing chart (at right)

Figure 7: (below) Packing blocks. (Forward spar web omitted)

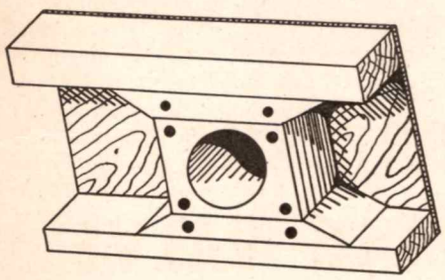




(A) STRIP TYPE



(B) SHAPED TYPE



(C) BLOCK TYPE

MINIMUM FITTING RADIUS: (BEARING ON WOOD.)		
BOLT DIAM. D	R : RADIUS (inches)	
	SPRUCE	HARDWOOD
*10-32	1/2	3/8
1/4	19/32	7/16
5/16	11/16	1/2
3/8	13/16	19/32
7/16	29/32	11/16
1/2	1	13/16

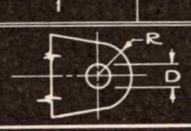


Figure 8

weight of about 15% over the equal depth flanges in most cases. Both flanges should be straight or have straight tapers for easy production. Where it is necessary to bend the flange, as in the case of many center section spars, the spruce must be cut into 1/4" thick laminations, bent and glued. Though this is a slower production job, the use of a phenolic glue impregnated into the spruce at the lamination joints give an "improved wood" or, under its more common tag, "plastic construction," which will compensate for the extra work by providing greater flange strength securely sealed from attacks by moisture.

At the root of the conventional outer wing spar, with its spruce flanges and packing, the end grain of the wood is exposed to the atmosphere, thus inviting attack by moisture. Inspection of spar ends, after extended periods of service, generally will show cracks that have developed through continuous shrinking and swelling caused by the changing moisture content of the sensitive end grain of the wood. Since ordinary spar varnish is inadequate to cope with this blotter-like tendency it is advisable to seal this vital spot with a strip of plywood.

Glued to the spar flanges are the plywood shear webs. For greatest shear strength, and therefore lightest construction, the face grain of the web should be at a 45° angle to the longitudinal axis of the spar. A further weight saving is possible by using a special 2-ply spruce that is available for spar webs. Most webs are reinforced with spruce stiffeners or diaphragms, 1/4 to 3/8" thick, glued and nailed to the inside faces. When stiffeners are used they should be located at rib stations so all ribs can be firmly glued and nailed to the web. The pitch of these stiffeners is important to web strength. Over the usual range of spar sizes and rib spacings spar webs, reinforced with stiffeners, have 20 to 30% greater shear strength than the same webs without this reinforcement.

In the box bounded by the webs and flanges, wherever fittings are attached, spruce packing blocks must be built in so attachment bolts will have sufficient bearing material. Packing blocks should be as light as possible, either by constructing them of strip material and locating the strips wherever bolts occur, or by solid blocks with large lightening holes. These blocks or strips should be designed so they gradually taper off into the spar flanges at less than a 30° angle, to avoid a rapid change in section with its accompanying stress concentration.

No attempt should be made to seal the inside of box spars from the outside atmosphere. Small drain holes must be drilled through at the lowest point of each closed compartment. In some designs it is standard practice to call for a .125" diam hole drilled in the spar web at the lowest level beside each packing block. These holes not only vent and drain the inside of the box but also permit inspection of the spar after it is finished. Spars have been known to be built with packing blocks, required for strength purposes, carelessly omitted. However, by slipping a piece of wire through this vent hole, spars can be double checked after assembly to make sure packings are properly in place.

Tolerances on Finished Product

Wooden spar layouts often worry the designer as he debates the tolerances to be expected on the finished product. In general the overall length of wood members will vary between the limits of ± .010" per foot run. Spar widths can be estimated by allowing .010" to .015" for each glue joint. This figure accounts for the thickness of the glue plus swelling of the wood due to the smearing on of the wet glue.

Ribs are usually slipped over and firmly fixed to the spars by gluing and bradding. Since spars shrink or swell in service, it is good practice to attach the ribs by gluing on two adjacent faces of their spar opening only—for example, bottom and front. This allows the spar a limited amount of freedom in two dimensions and helps prevent the rib-spar joint from opening out. Instead of skidding the ribs over the spars, another method of construction is to build the spars to the full depth of the airfoil and make the ribs in separate pieces, similar to those in a metal wing. The individual parts are then butted against the spars and fixed in position with corner blocks. Though this type of construction allows a greater spar depth, and therefore a lighter one, it is generally slower

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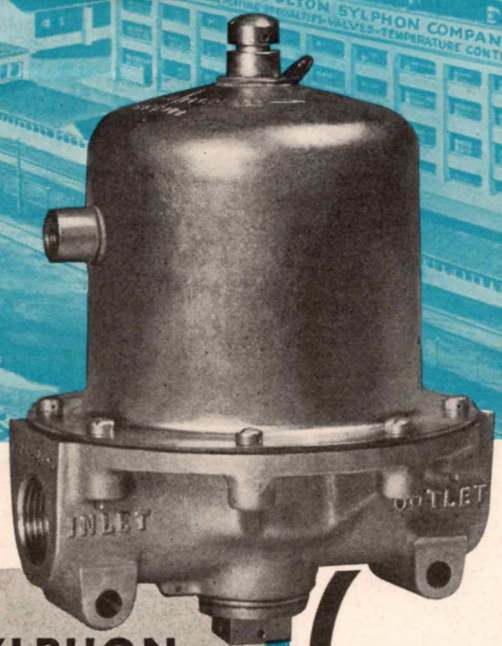
See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

SYLPHON AIRCRAFT CONTROLS



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(Continued from preceding page)
and more difficult to assemble the ribs to the spars. In modern practice the full depth spar is often used in the short span, center section panel where there are fewer ribs and the additional spar height can be beneficially used to carry the heavy loads.

Spars must also support a variety of metal fittings. Though fittings for wooden spars follow the same general design rules as those for all-metal construction, two major design points should be noted.

(1)—Wrap-around fittings that completely enclose the spar should be avoided if possible. This type of fitting is generally so rigid that it is impossible to retighten its attachment bolts to pull it snug against the spar after the wood has shrunk.

(2)—All corners, of any fitting that bears directly on the wood, should have a larger corner radius than is generally necessary for strength purposes. This additional area is essential to ensure a large bearing surface against the face of the wood and to prevent the mechanic from so tightening down the bolts that the fitting sinks into the spar and damages it.

Use of Small Steel Washers

For fittings which are duplicated on both sides of the spar, such as those at the wing root joint, it is advisable to fit small steel washers (AN960) under the nuts of all fitting bolts, whether they require them or not, so bolts can be quickly and easily pulled up after the spar has settled to size. With the usual arrangement of omitting the washer and having the grip length of the bolt pass clear through the spar and fitting, there are generally no available threads to permit retightening of the nut. However, with the washer under the nut sufficient threads can be provided on the bolt, hidden by the washer, to allow several additional turns on the nut to take up any slack. In some instances, depending on the grip length of the standard bolt selected, washers may be required under both bolt head and nut. If these are not called for on the original factory blueprint, new or rethreaded bolts may have to be fitted after the ship is in service.

If a metal fitting, such as a drag wire lug, is used on one side of the spar only, the hold-down bolts must have wood washers (AN970) under the nuts to prevent crushing of the wood when the bolts are tightened. It is actually cheaper, and quicker for replacements, to specify AN Standard washers for this job than to design a special washer plate. A useful dodge, where bolts are too closely spaced, is to use standard washers clipped along one edge to avoid their overlapping. In cases where a fitting is subject to a variable load, such as an aileron hinge bracket, the washer plate on the opposite side of the spar is preferred, instead of the individual washers, since its larger bearing area helps prevent incessant rocking of the bracket under load.

Fitting bolts should be generously spaced to check any tendency of the wood to shear along the grain between holes. The diameter of these bolts is generally set by the bearing strength of the wood since the latter is the softer material. To avoid using a larger diameter bolt than is necessary to carry the shear or tensile load, either a metal bushing can be pushed into the wood, or plywood facings, glued to each side of the spar, can be added to increase the bearing strength. Where bolts are sufficiently large so stripping of the threads is not likely to occur, bearing area can be boosted, with less weight, by using aluminum alloy bolts of larger diameter.

Protection from Rough Handling

Fittings, bolts and the main structure of the wing are to some extent protected from the atmosphere by the wing covering. If the wing is not completely covered with plywood it is advisable to at least enclose the nose portion to maintain a smooth contour. Furthermore, a substantial leading edge member, butted and corner blocked to the ribs, should be hidden beneath the ply. Wings are generally stored and moved with their leading edge down and this smooth surface often is subjected to rough handling—a point sometimes overlooked by the designer but constantly present in the minds of maintenance men. The leading edge covering is approximately 1/16 plywood, glued and nailed with the face grain running spanwise so it can be readily bent to shape. For maximum torsional stiffness it should extend past the spar on the upper and lower surfaces, with the usual drain holes at the lowest point beside each rib. However, if the covering is left 2″ or 3″ clear of the spar, on the lower side only, a useful gap is provided for inspection and repair of the fittings and the forward face of the spar.

The after edge of this ply covering, particularly on the highly cambered upper surface, will leave a hard unsightly line on the covered wing. A method used on several types of British airplanes to overcome this, is to let the edge overhang the spar by 2″ or 3″ and scollop this loose portion at rib stations. The uneven edge is then comparatively flabby so it bends easily to fair neatly into the contour of the taut fabric covering. The finished surface, therefore, appears quite smooth and there is no distinctly visible edge under the fabric. This not only helps aerodynamically but also adds to the airplane's eye appeal.

Torsionally Braced Skin

For the smoothest surface, however, the wing should be torsionally braced by a complete plywood skin. The best strength and lightest structure will result with the 3-ply laid with the face grain at 45°. When casein glue was used to hold the layers of wood the ply covering was none too popular since the individual glue joints tended to open out, under adverse conditions, like the leaves of a book. However, with modern phenolic glue bonding this is no longer a problem and ply coverings wear well under extreme climatic conditions. As with the box spar, no attempt should be made to seal the structure from the outside atmosphere and the usual drain holes must be provided at the lowest point of each closed space. Though the maintenance man often frowns on this "match box" type of construction, adequate inspection openings at all main structure and control system joints can make it as serviceable as the all-metal wing.

To give the outside of the plywood skin a smooth finish, prevent weathering and cracking, and increase resistance to penetration by obstacles thrown up by the landing gear wheels, it is advisable to glue a thin layer of light covering fabric over the whole surface before finishing. On two test panels, one covered with fabric doped over the ply and the other with it firmly glued thereto, the latter gave the smoothest finish. Practically no evidence of the cloth base was apparent after the last pigmented cover-

(Continued on page 179)

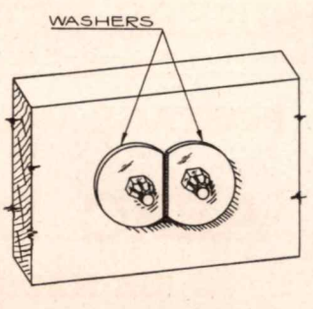


Figure 9: Clipped washers

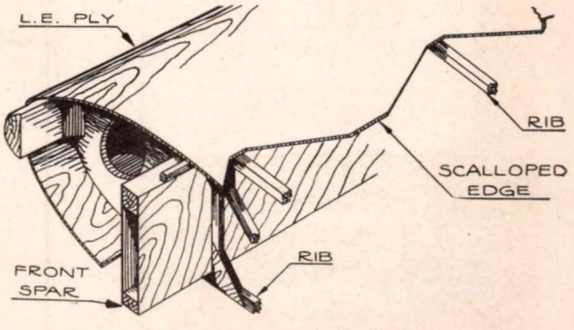
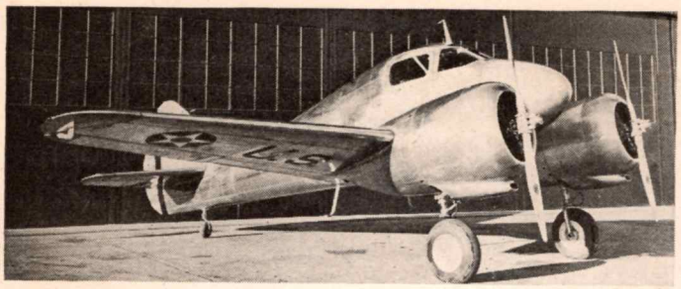
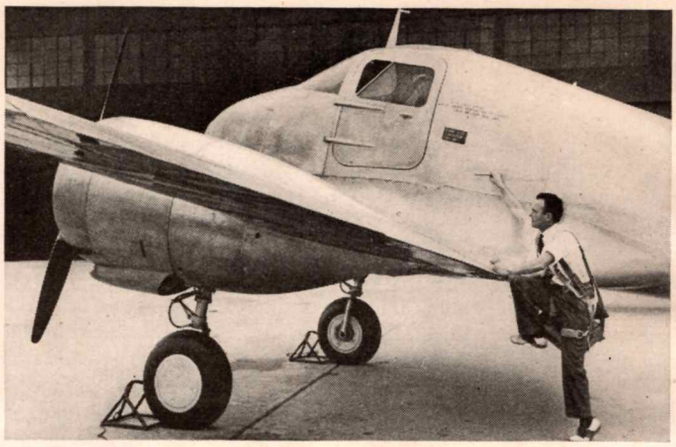


Figure 10: Scalloped leading edge ply

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue





Curtiss AT-9 Trainer

● Development by the U. S. Army Air Forces of a new type of twin-engined plane for the training of pilots for high speed, multi-engined fighters and bombers was announced last month by the Curtiss-Wright Corp., through G. W. Vaughan, president. The first plane already has been delivered to the Army for accelerated service tests.

Designated the Curtiss AT-9, the new trainer was designed by the St. Louis plant of the Curtiss-Wright Airplane Division to shorten the long and difficult step which many pilots experience in transferring from the single-engine, low-powered training airplane to the latest types of multi-engined tactical aircraft. It therefore incorporates the same general performance and operating characteristics of the latter type including instruments like the automatic pilot.

AT-9 is an all-metal, low-wing monoplane equipped with retractable landing gear of the conventional type and has two side-by-side seats with provisions for two additional seats immediately back of the pilots. It is powered with two Lycoming 280 hp radial, air-cooled engines, has a fuel capacity of 150 gal, and incorporates many features in accordance with specific training demands stipulated by the Army Air Force.

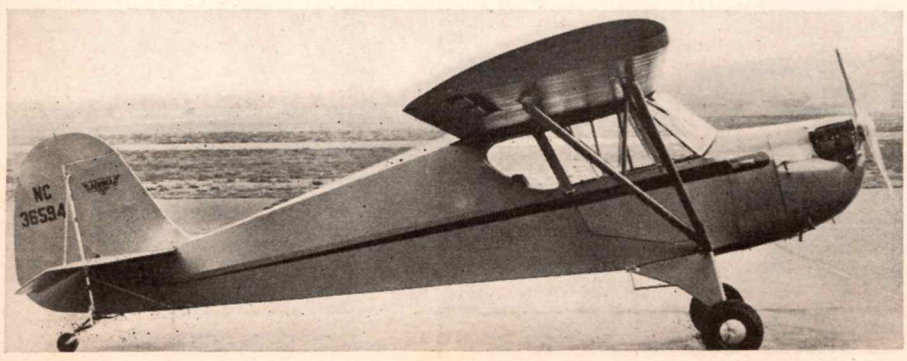
The new plane has a maximum speed of more than 200 mph, a range of 750 miles, and is ideally adapted to mass production. A large number will be produced in the new Curtiss-Wright Airplane factory, Lambert Field, St. Louis.

Aeronca 1942 "Defender"

● Incorporating numerous refinements in construction, the 1942 Aeronca tandem trainer is now in production at the Middletown, Ohio plant of Aeronca Aircraft Corp. Designated the *Defender*, the two-place high wing monoplane shows evidences of extensive re-engineering both inside and out.

Engineered for a 65 hp engine, the airplane now has for standard equipment an improved type muffler. Engine cowling has been modified and strengthened around the base of the windshield to reduce engine noises in the cabin. Windows have been redesigned and felt has been installed on all surfaces that come into contact with the pyralin to avoid scratching of the windows. The door has been redesigned and it is now hung on two hinges—one in the center of the door attached to the outside of the fuselage 6″ ahead of the frame, and the lower hinge on the outside edge of the door attached to the frame. This permits better accessibility to the cabin. General door construction has been materially strengthened.

Aeronca 1942 Trainer, a 65 hp tandem seat monoplane



Control Loads Reduced

Heavier vertical tubes have been installed on each side of the cabin eliminating a diagonal cluster and also materially strengthening the entire side of the fuselage. Exceedingly rough landings will now transfer shock through the gear and up through this tube to spend itself through the various connecting members. Addition of this oversize tube will insure fuel fuselage protection against bad "stall outs" in landings.

Control system operating loads have been materially reduced through a series of modifications. Leverages on all control surfaces have been changed. Approximately 1.5 sq ft of area has been taken off the rudder which has been balanced to provide exceptionally light forces. Aileron chord has been decreased and is now of the slotted semi-fringe type, differentially controlled. Elevator movement has been lightened by a change of leverage between the stick and the shaft.

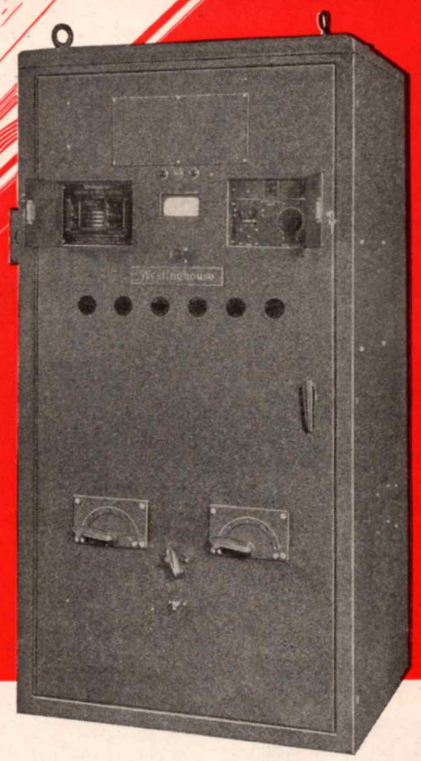
Four inches have been added to the fuselage at the bottom of the cabin. Seats are wider and have improved backs. Leg room around the rudder pedals has been increased. The student seated in the rear seat is still approximately 5″ higher than the instructor in the front seat.

Instruments have been rearranged with the altimeter and tachometer on the outer edges of the panel. The airspeed has been moved to the center of the panel, and the ignition switch to the right side of the cabin above the door where it is easily accessible to both occupants.

In addition to these improvements, the oleo landing gear has been improved. Standard brakes are of the improved Shinn type.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

it's a "POWER BANK" for America's Aircraft Industry



DEPOSIT A-C POWER... withdraw accurately controlled surges of D-C current for more uniform welding of aluminum

Tough job, aluminum welding. You need comparatively high voltage in a narrow current range. Aluminum and other alloys used in modern planes have a very narrow plastic range. How to get the exact welding current you need without disruptive surge demands on power systems, without installing costly auxiliary equipment, has long been a problem.

CONDENS-O-WELD solves the problem. Energy is drawn from a 3-phase a-c power line, rectified, stored electrostatically and released in accurately controlled discharges to the welding machine. A complete, compact, enclosed unit, Condens-O-Weld can be used with any electrostatic stored energy type resistance welder.

With precision control of voltage, current and wave form, aircraft producers are getting welds of uniform strength and soundness not possible with any previous method. If your welding problem demands action now, you'll be glad to learn that Condens-O-Weld units are *ready now!* For detailed data, write Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.

3 WAYS

CONDENS-O-WELD HELPS KEEP PLANE PLANTS AT PEAK EFFICIENCY

1. **BALANCED 3-PHASE LOAD**
Power requirements spread over three phases, not concentrated in surge demand on a single phase.

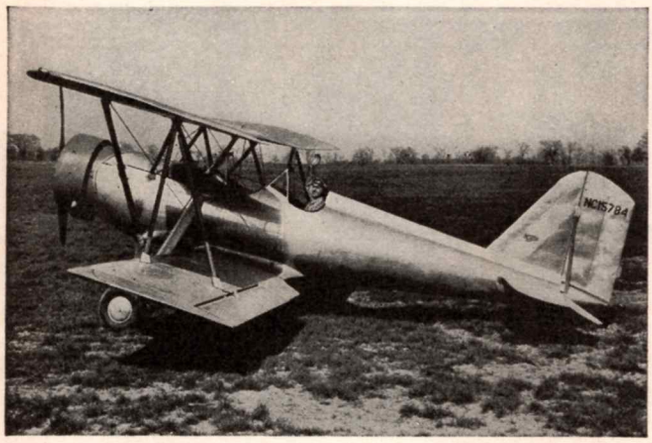
2. **HIGH POWER FACTOR**
Power factor approaches unity.

3. **MINIMUM PEAK KV-A DEMAND**
Fast charging rate with efficient electrostatic storage of power cuts peak Kv-a demand to a minimum.

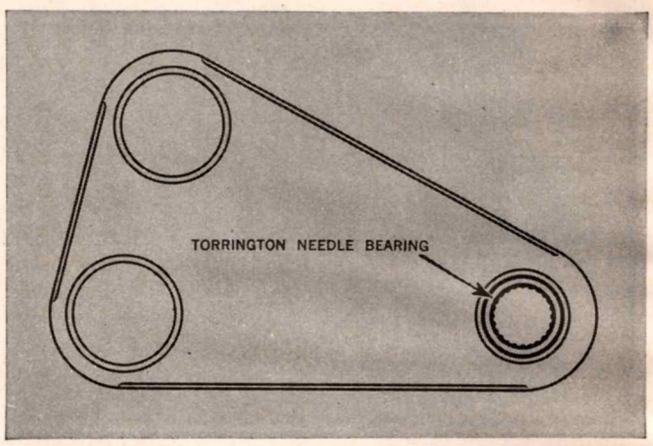
J-21173

Westinghouse CONDENS-O-WELD

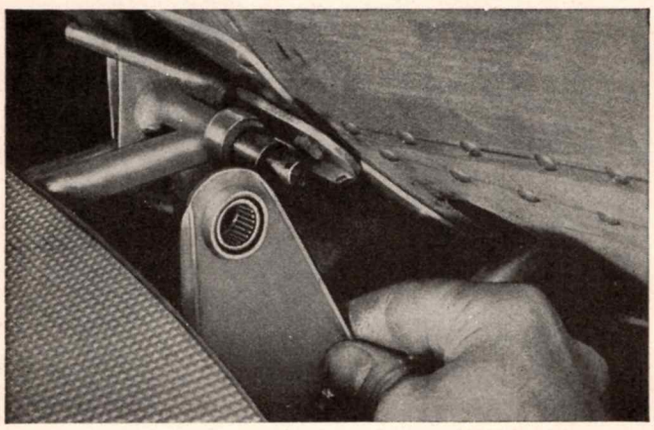
TORRINGTON NEEDLE BEARINGS SIMPLIFY DESIGN SPEED ASSEMBLY AND WITHSTAND STRAINS IN MEYERS TRAINERS



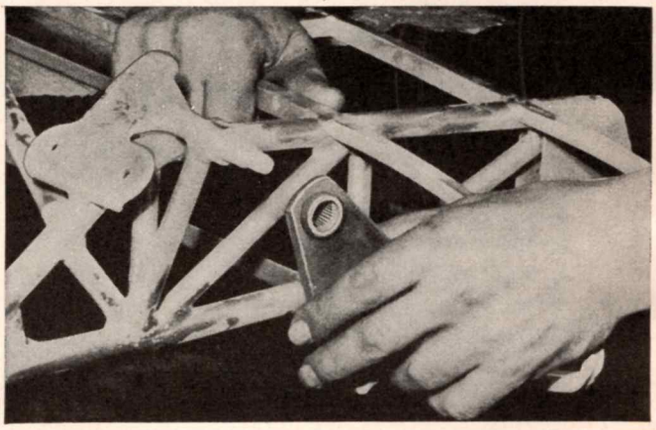
1 MEYERS OTW TRAINER is used for advanced instruction—almost exclusively in acrobatics—by Civilian Pilot Training Program operators. To withstand the severe strains imposed by stunt flying, Torrington Needle Bearings are used in the controls of Meyers planes.



2 AILERON CONTROL is dependent on Torrington Needle Bearing. According to Meyers Aircraft Company engineers, "Use of the Needle Bearing helps to assure constant alignment, reduces any possibility of jamming, and maintains a low coefficient of friction throughout its long life."

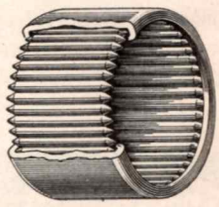


3 THE SMALL SIZE of Torrington Needle Bearings permits important savings in dimensions, weight and cost of the surrounding assembly. They have high load capacity, yet require no more space than plain bushings, thus allowing simplification of design. Lubrication, moreover, is no problem, because Needle Bearings store large supplies of lubricant.



4 ASSEMBLY TIME is reduced "because control bellcrank, enclosing Needle Bearing, is easily slid onto shaft." And being self-contained units, made to accurate dimensions, Needle Bearings are quickly installed in housing, or, reports Meyers Aircraft, "If the occasion ever arises, they may be replaced rapidly without special tools."

If you have a bearing problem where high load capacity, small size, light weight, ease of assembly and lubrication are important, investigate the advantages of the Torrington Needle Bearing. Our Engineering Department will be glad to work with you in adapting them to your assemblies. For details write for Catalog No. 112. For Needle Bearings to be used in heavier service, consult our Engineering Department for special bearing designs.



THE TORRINGTON COMPANY, TORRINGTON, CONN., U. S. A. · ESTABLISHED 1866

Makers of Needle and Ball Bearings

New York Boston Philadelphia Detroit Cleveland Chicago London, England

TORRINGTON NEEDLE BEARING

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

KINNER R-53 ENGINE

Particularly Adapted for Use in Training Airplanes

● With the receipt of its ATC a few months ago, Kinner Motors, Inc., is now in production on the R-53, a 5-cylinder radial air-cooled engine rated 175 hp at 2100 rpm. Providing fifteen hp more than the R-55 which is used in the Army's Ryan trainers, the new engine can be used as a replacement not only for that model but also for the 125 hp B-54, inasmuch as mounting dimensions on all three are identical. The B-54 is used chiefly in Canadian Fleet Trainers.

Developed by Charles Sander, Kinner's chief engineer, and his staff, the R-53 adheres to basic Kinner principles. It is particularly adapted for training purposes in that it is not supercharged and develops its maximum power at sea level.

It has a displacement of 540 cu in and a compression ratio of 6:1. Bore is 5″, stroke 5.5″. Weight is approximately 351 lb without propeller hub, air heater, exhaust collector ring, starter, generator or fuel pump.

Structurally, the R-53 has a number of features among which is the complete circulatory oil system which has been designed to minimize the number of outside lines.

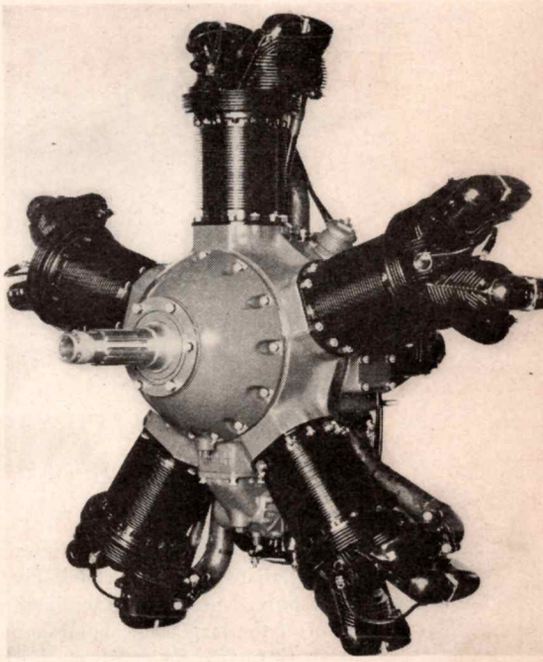
In this system the oil from the oil tank is forced by pressure pump through internal passages to the front main bearing and from there through the crankshaft to the pressure relief valve, which is built integral with the oil pump. The oil is scavenged by the scavenge pump from the oil sump, and both scavenged oil and oil from the sump is returned to the tank through a single oil line.

The engine can be furnished with a Cuno oil filter, which is installed in the oil sump and is readily accessible for hand turning. With the Cuno filter installed, oil from the pressure pump passes directly through the filter before entering the bearings. The type of filter used is equipped with a relief by-pass valve to prevent build up of excessive pressure when the oil is cold or congealed.

Also of interest is the R-53's master rod. The traditionally sturdy Kinner master rod has been made even stronger and heavier, with a larger bearing area. Main bearings are of the copper-lead type.

Other features of construction include the use of left-handed taper type spark plug inserts and a new-type push rod inclosure with a tension spring at the lower end of the tubing. This spring is inclosed in another tubing.

The R-53 comes equipped, as desired, with either a Stromberg (NAR6) or Holley (419) carburetor, with two Bendix Scintilla magnetos, and two tachometer drives. It also can be furnished with adapter for either hand or electric starters, as well as with drives for generator, fuel pump, vacuum pump or gun control.



The 175 hp Kinner engine

DESIGN OF WOODEN WINGS

(Continued from page 175)

ing coats had been applied.

To attach the plywood at the wing tip, it can be clipped or laced to a metal tube, or glued and bradded to a wooden bow. When formed from spruce the bow must be laminated—usually six to ten .125″ thick laminations are sufficient. This gives a better contour than can be obtained with a metal tube since the wood can be shaped, and tapered in depth, from the thick leading edge to the thin tip and trailing edge. The mating leading and trailing edge pieces can also be contoured from solid spruce, though unless the airfoil is particularly thick at the rear, a trailing edge strip, made from a flattened tube or a piece of bent metal sheet, is somewhat easier to clip to the ribs.

The strength criterion for this trailing edge is the fabric tension on cloth-covered wings. It should also be noted that other parts of the structure may have to be braced against this load, particularly end ribs at the root, aileron or flap openings. In the case of low-wing airplanes, with walkways over the wing at or near the root, the plywood stepping surface, usually 1/8 to 3/16 ply supported by battens on the underside, will serve to brace the upper capstrip against the tautness of the fabric. A gusseting member, running diagonally from spar to capstrips, however, will usually take care of this load.

With adequate fabric-tension bracing, careful design of fittings, sufficient provision for drainage and full allowance for the effects of shrinkage, the wood wing presents the answer to small plane wing construction. Furthermore, when the structure is covered with a smooth plywood skin, free of drag producing rivet heads, the additional aerodynamic efficiency accounts for a better rate of climb and more miles-per-hour on the maximum speed.

WHAT ABOUT DRIFT?

(Continued from page 54)

reference point, it will be seen traveling along the sighting wires of the drift indicator as it comes into the field of view of the sighting tube. The drift scale will also read zero, the heading and the track being equal.

Now, however, in considering the airplane passing between the same two points, A and B, on a day when there is a cross wind, it is evident that the airplane will have to be headed into the wind to make some predetermined track. (See fig. 1.)

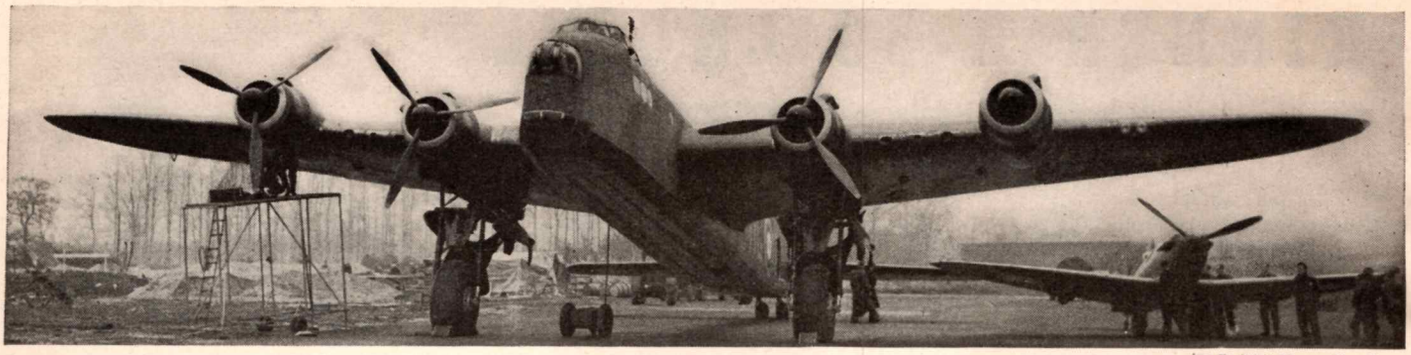
If, as the object is passed over, the plane is kept on the desired track, then there will be an angle between the heading of the plane and its path over the ground. This is the drift angle. As the object comes into the field of view it will be seen to cut across the sighting wires; by turning the wires so that the object runs parallel with them, the drift angle will be read from the scale. (See fig. 6.)

From the foregoing, it is obvious that any good landmark, which is easily discernible will serve the purpose well. In cases where a greater part of the flight is made over water, flares are used, and as they lie on the water, drift readings are taken on the smoke which offers a means of checking the drift of the plane. It is also possible to take readings on the definite lines resulting from the varying depths in water, although these are not as desirable as the flares. Whitecaps also offer a ready checkpoint under certain conditions.

Drift indicators may be used to advantage on flights where accurate navigation is required, and when the observed data is used in conjunction with the previously mentioned methods of computing wind force and direction, surprising results will be obtained.

The real importance of the drift indicator can be fully realized if consideration is given to the many instances under which accurate wind data is necessary. Aside from being a requisite of regular navigation work, it must be known in problems of aerial photography as well as in bombing operations.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



British Press Service

SHORT "STIRLING" BOMBER

● There has been considerable interest concerning British four-engined heavy bombers, spurred perhaps by the increasing extent of the large-scale bombings of industrial Germany, as well as Berlin and other major cities.

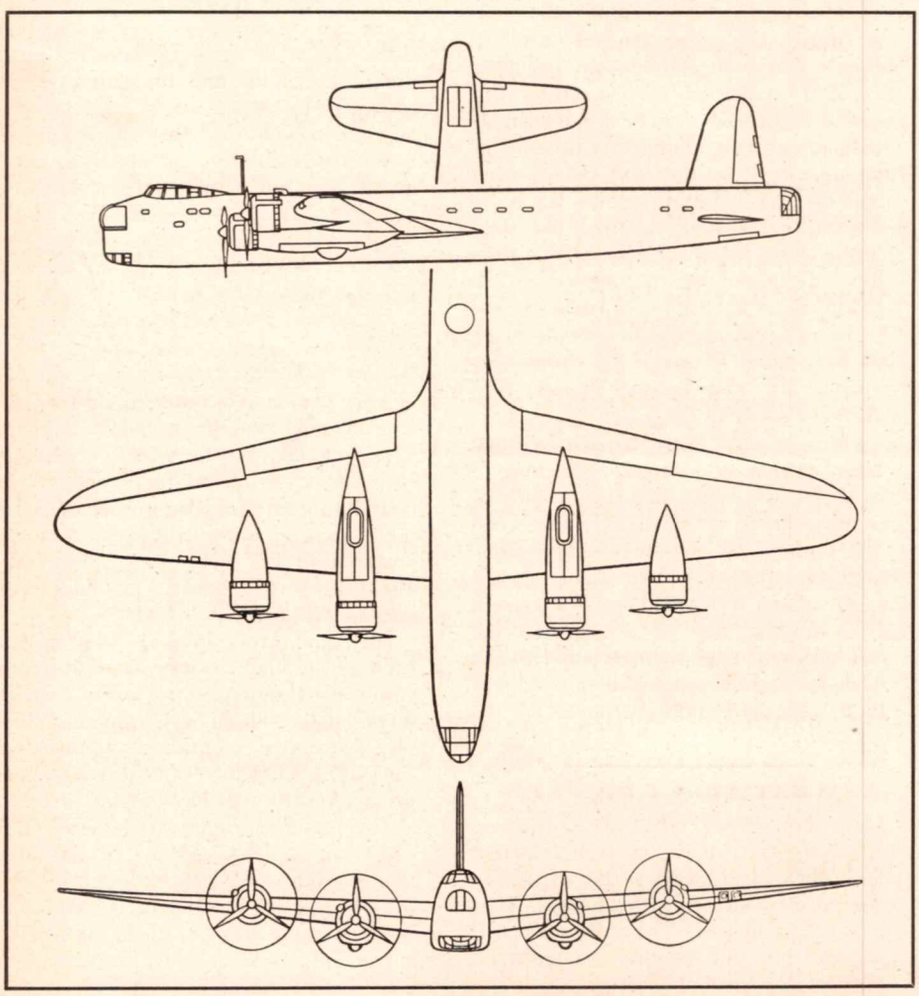
Comparatively little data has been released on these new British types, and although the Short *Stirling* has been frequently mentioned in Air Ministry communiques this airplane has not yet been given extensive publicity. Actually, it has been only of late that photographs and drawings were made available.

In general, the *Stirling* is a monoplane with a highly tapering midwing design, having a fuselage of approximately rectangular cross-section. Its landing gear is retractable and there is a double retractable tail wheel. Slightly unusual is the placement of the inboard engines in an underslung position and slightly ahead of the outboard engines.

There are bow and stern gun turrets, and the bomber-aimer's position is immediately under the bow gun turret. The pilot's compartment is raised above deck level near the nose, well forward of the propellers. Windows along the sides of the fuselage are intended to provide a well-lighted interior along the entire length. Bomb doors extend approximately half the length of the fuselage.

Power is supplied by radial air-cooled engines equipped with three-bladed propellers. Either 14 cylinder Bristol *Hercules* sleeve valve engines of 1400 hp each, or double row Wright *Cyclones* may be used.

Having a length of 87.25′, a span of 99′ and a height of 22.75′, the *Stirling* is somewhat smaller in span but longer than the Boeing bomber.



Three-view outline drawings of the British 4-engined Short "Stirling" heavy bomber

BLACKBURN "BOTHA I" OPERATIONAL TRAINER

● Before taking over their actual service machines, a large number of RAF bomber crews are now receiving their final training on the Blackburn *Botha I*. Little has been heard in the press of this aircraft (a general reconnaissance and torpedo bomber) since announcements of its existence were made early in the year, but it has been doing useful work in the operational training squadrons.

First seen in 1939, the *Botha* was produced to meet a general purpose specification which was laid down before the outbreak of war, when the trend of hostilities seemed to indicate that aircraft of certain performances would be the types likely to be in demand.

With the changes which followed in the course of the war from what had originally been envisaged, tactical and strategical alterations in the British plans were necessary, and certain specifications, of which that of the *Botha* was an example, became out-dated almost overnight.

Nevertheless the aircraft is completely equipped for service work and is therefore an excellent operational trainer. The bomber crews are given for the first time an opportunity of handling a fast and modern machine in practically all respects the equal of the bombers they will later fly.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

NO. 8

ALUMINUM, DEFENSE, AND YOU

OCTOBER WAS A MILESTONE MONTH

There have been three other such milestones for civilian uses of aluminum during the past 18 months.

WHEN, ON MARCH 25, 1940, the price of Alcoa Aluminum ingot was reduced from 20c to 19c a pound, it automatically increased the number of civilian applications where using aluminum would be good cost arithmetic.

19¢

Every application carries its own special set of conditions. They determine how much you can pay to save a pound of weight, to get extra heat conductivity, or reflectivity, or what not. 19-cent ingot widened the circle of aluminum's usefulness.

AUGUST 1, 1940 WAS THE SECOND milestone. Economies growing out of greater volume of manufacture, and economies stemming from continuing research, brought the announcement of 18-cent ingot. The civilian manufacturer looking to his future could see, in the offing, more ways to use aluminum than ever before.

18¢

Perhaps you were one of the thousands who filed away in your book of futures the reminder that "when this thing is over, we must figure on using more Alcoa Aluminum."

THIRD MILESTONE showed up almost before you got that note made. November 18, 1940 saw another reduction on Alcoa Aluminum ingot to 17c a pound, making a total reduction of 15% in the midst of a general seller's market.

17¢

Defense got most of the immediate benefit, but the future of aluminum for you, and you, and you, was writ larger than ever.

THEN CAME 15c INGOT, effective Oct. 1, 1941, with accordant reductions in fabricated forms of Alcoa Aluminum. This means that the arithmetic of weight saving is all new, since last you figured on using this versatile metal in a civilian application. When the emergency is over, the fact is that all your old material cost comparisons will be as dead as a dodo.

15¢

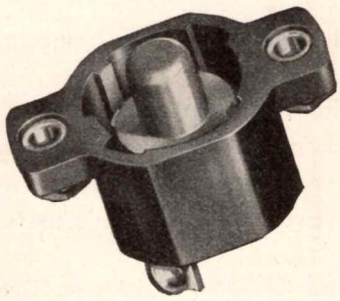
THE ARITHMETIC IS NEW; but the fundamentals just get more so! More than ever, the strong alloys of Alcoa Aluminum are *the* answer to lightness with strength.

ALUMINUM COMPANY OF AMERICA

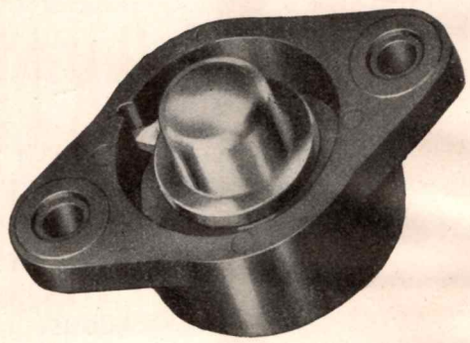
See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

FOUR NEW CIRCUIT BREAKERS

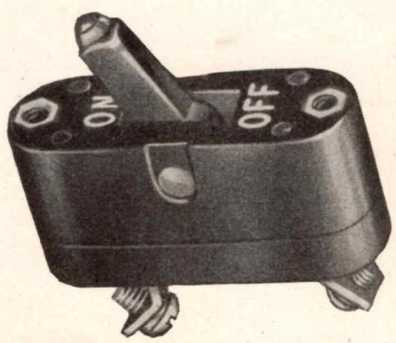
For Aircraft Use



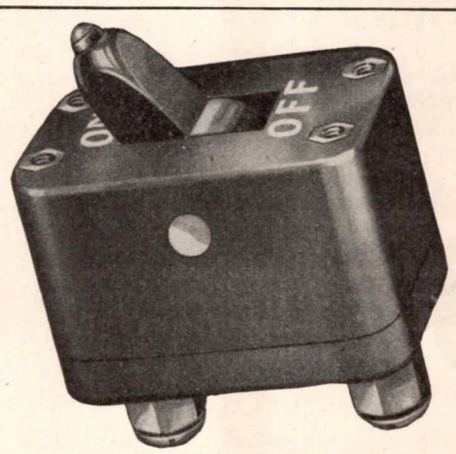
Klixon NAF-1131 circuit breaker. Approved for military aircraft use. Weighs only 1¼ ounces. Has high rupturing capacity—500 amps at 30 volts D. C. or 220 volts A.C. Ratings from 5-40 amps in steps of 5.



Klixon PLM-1½" circuit breaker. Used for higher ratings than the NAF-1131. Compact and light in weight. Has high rupturing capacity. Ratings range from 35 amperes up. Comes with or without luminous tip on reset button.



Klixon Switch-Type Circuit Breaker — Type C-6363. Small, compact, and light in weight, this breaker is interchangeable with respect to mounting demensions with standard aircraft toggle-switch. Ratings from 5-30 amps in steps of 5. Comes with or without luminous tip.



Klixon Switch-Type Circuit Breaker—Type C-6364. It is light for its size. Has high rupturing capacity. Being twice the width of the C-6363 it can be mounted in same space as two C-6363's. Ratings range from 35 amps up. Comes with or without luminous tip.

More and more military planes are coming off the lines equipped with Klixon Circuit Breakers. For these devices are permanent protectors—breakers that can be reset repeatedly simply by pushing a button or throwing a switch. Operated by a simple snap-acting, thermostatic disc—scientifically calibrated—these breakers are shock resistant and immune to vibration. They are unaffected by harmless temporary short circuits but give foolproof protection against harmful short circuits and overloads.

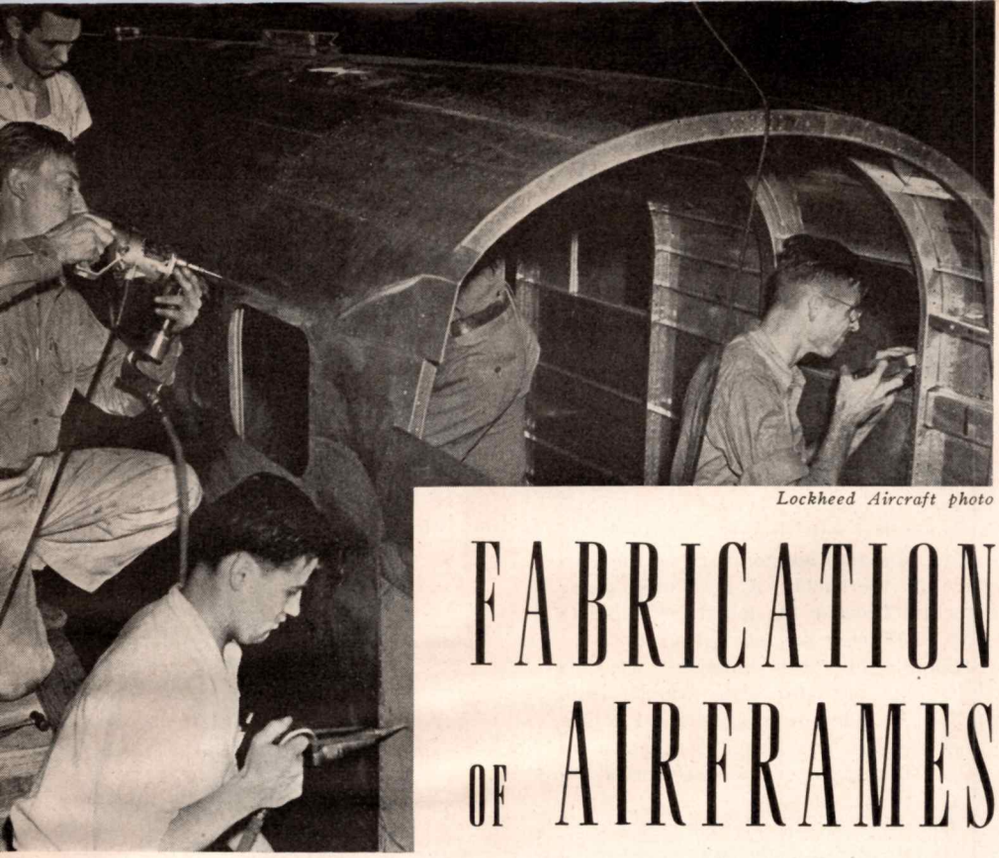
Being small and compact, Klixon Circuit Breakers are easily adaptable for panel mounting. They are available with self-locking nuts and are made of corrosion resistant materials. Bulletins containing complete information are available. Send for copies.

KLIXON
TRADE MARK REG U.S. PAT. OFF.

Spencer Thermostat Co., 1211 Forest St., Attleboro, Mass.

MANUFACTURERS OF THERMOSTATS AND TEMPERATURE CONTROLS FOR AIRCRAFT CABINS, RADIOS, ENGINES AND INSTRUMENTS

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



Drilling and riveting operations in the assembly of a Lockheed fuselage

Lockheed Aircraft photo

FABRICATION OF AIRFRAMES

● Working aluminum alloys in the relatively thin gauges used in aircraft construction requires a different technique than that employed in other industries. Many of the newcomers to the aircraft industry already have learned this lesson, but there still is a training job to be done on the thousands of new men now being added to aircraft payrolls each day. Demands for information about aluminum alloys have increased in proportion to the mounting employment. As a result, the Aluminum Company of America issued a new booklet called *Aluminum in Aircraft* of which the following is a part covering the chapter on Airframe Fabrication.

Aluminum alloys are fabricated on the machines and equipment normally employed for other metals. The quantity of identical parts involved, the nature of these parts, and the particular alloy and temper used, dictate the details of methods, tools and dies.

Cutting and Blanking

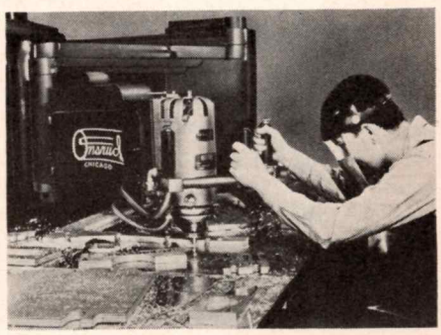
One of the first fabricating operations involves the cutting of rectangular sheets of metal into the sizes and shapes required for the individual parts of the airframe. The methods used are classified as shearing or cutting.

Equipment for shearing includes guillotine shears (either power- or foot-operated) for making straight cuts; roll shears for curves; male and female blanking dies; and a variety of modifications of these. To obtain sheared edges with minimum burr, the cutting edges must be smooth and sharp, and set with a clearance equal to about 7% to 10% of the thickness of the metal being cut. The use of metal dies and rubber pads[1] for blanking sheet metal has been increasingly popular.

Two types of cutting are used on sheet stock: sawing and milling (or routing). Band saws are sometimes used for cutting stacks of sheet-metal blanks and both band and circular saws are used for miscellaneous work on sheet and extruded sections. High blade speeds (5000 fpm for band saws and 10,000 fpm for circular saws) are desirable for best results, and saw teeth should be fairly coarse with a slight set and front rake.[2] An increasingly used method for cutting stacks of sheet-metal blanks involves the use of routers. The cutter is a small diameter milling tool which turns at high speed on a vertical axis. It is guided by a template clamped to the work and cuts a path all around the blanks equal in width to the diameter of the cutter. This method leaves the edges of the blanks in a smoother condition than when the metal is sawed.

Forming

Most of the forming work[3] in the aircraft industry is done on sheet. In general, the equipment consists of basic ma-



High speed routing machine used to cut a number of metal sheets at one time

TABLE 1

Conditions for Heat Treatment of Aluminum Alloys

Alloy	Solution Heat Treatment[1]			Precipitation Heat Treatment		
	Temperature, Deg. F.	Quench[2]	Temper Designation	Temperature, Deg. F.	Time of Aging	Temper Designation
14S [3]	930–950	Boiling water		335–345	10 hours	14S-T
17S	930–950	Cold water		Room	4 days [4]	17S-T
A17S	930–950	Cold water		Room	4 days [4]	A17S-T
24S	910–930	Cold water		Room	4 days [4]	24S-T
53S	960–980	Water [5]	53S-W	315–325 or 345–355	18 hours or 8 hours	53S-T
61S [6]	960–980	Water [5]	61S-W	315–325 or 345–355	18 hours or 8 hours	61S-T

[1] See Table 2 for soaking times.

[2] It is essential that the quench be made with a minimum time loss in transfer from the furnace.

[3] Alloy 14S forgings should be held at heat-treating temperature for 12 hours. Details of heat treatment for forgings may vary somewhat, depending on the size and shape. Aluminum Company of America is pleased to consult on any special problems that arise.

[4] More than 90 per cent of the maximum properties are obtained during the first day of aging.

[5] The water temperature is not critical.

[6] Precipitation heat treatment at elevated temperatures is patented.

TABLE 2

Typical Soaking Times for Heat Treatment

Thickness	Time in Minutes for Various Alloys		
	17S and Alclad 17S	24S	Alclad 24S
Up to 0.032″	20	30	20
0.032″ to ⅛″	20	30	30
⅛″ to ¼″	30	40	40
Over ¼″	60	60	60

Notes: 1. Soaking time starts when the metal (or the molten bath) reaches a temperature within the range specified above (Table 1).

2. The soaking time shown for 17S can also be used for alloys 53S and 61S.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

chines which are fitted with special tools or dies for each part they are to process. Thus a double-action mechanical press would be equipped with a number of sets of punches, dies and blankholders.

Single-action presses, usually hydraulic when large in size, are used extensively. The large hydraulic presses are usually fitted with a rubber pad on the ram, both for blanking and forming. Because there is no tendency to "iron" or draw out wrinkles when metal is formed over a die (metal, wood or synthetic material) with a rubber pad, it is common practice to notch the flange and also to provide flutes or scallops in the flange to use up the excess metal. Parts formed by this method usually have a somewhat flat surface surrounded by a flange, as for example a curved channel, a wing rib or a flanged bulkhead. Mechanical presses equipped with metal dies are used for a number of forming operations and simple draws, usually on small parts.

Drop hammers, using zinc alloy dies and lead punches cast in the die cavity, are extensively used. Many of the parts produced in this manner could be drawn on a double-action press at a lower unit cost, but a large number of parts is required to justify the higher cost of steel dies. Sheet panels for wing tips, fins and control surfaces as well as fairings and fillets are made by this method.

Sheet panels having slight double curvature are sometimes formed by stretching them over a metal or hardwood form. The sheet is wrapped over the form and is clamped along two opposite edges. The form is then raised so that the sheet becomes tight over the higher parts. Further motion of the form stretches the tight parts until the panel fits the form at all points.

Apron brakes, folders, cornice presses, rolls and draw-benches are used in making the many parts requiring bends that are not curved. These include corrugated sheet and sheet molding for structural uses in the airframe.

Some handwork is used in forming aircraft parts. Part of this work is done by skilled power-hammer men who form sheet panels to create the necessary curvature or crown. Other parts are made by hammering over or into various wood forms. Even in production work where tools have been provided, some hand straightening and adjusting may be necessary. In general, larger quantities justify more nearly perfect tools which, in turn, reduce or eliminate handwork.

Tools must be smooth and well-lubricated so that movement of the metal over the tool surface will not be impeded. Rough spots or poor lubrication can cause particles of aluminum to tear out of the work and build up on the tool surface. This condition is accumulative and once under way becomes progressively worse. In addition to marring the surface of the metal, it may even cause fracture because the metal is unable to slip easily over the tool surfaces.

Soluble oils are sometimes used as lubricants, but more often a mineral oil, tallow, paraffin or a mixture of tallow and paraffin are better for the more severe forming operations such as drawing.

Wherever possible, forming should be done on material in the fully heat-treated and aged condition. When this is not possible, it should be done immediately after heat treating when the metal is in a more workable condition than it is after "aging." Since flat blanks for subsequent forming will warp when they are quenched in cold water, it is sometimes necessary to partially flatten them before they are formed. Much of the heat treatment in the aircraft industry is done after the parts are formed or partially formed from annealed stock. This often involves straightening or reshaping operations, which are most easily done before age hardening has progressed too far. Under these circumstances some work is saved if the entire forming operation is performed on blanks which have been freshly heat treated. Table 3 will serve as an indication of the bending characteristics of various alloys and tempers.

TABLE 3

Approximate Inside Radii for 90° Cold Bend in Sheet

Minimum permissible radius varies with nature of forming operation, type of forming equipment and design and condition of tools. Minimum working radius for given material or hardest alloy and temper for a given radius can be ascertained only by actual trial under contemplated conditions of fabrication. The values in this table may be considered a relative index of workability.

Alloy and Temper	Bend Classification[1]	Alloy and Temper	Bend Classification[1]
2S-O	A	24S-O [2]	B
2S-¼H	B	24S-T [2] [3]	J
2S-½H	B	24S-RT [2]	
2S-¾H	D		
2S-H	F	52S-O	
		52S-¼H	
3S-O	A	52S-½H	
3S-¼H	B	52S-¾H	F
3S-½H	C	52S-H	G
3S-¾H	E		
3S-H	G	53S-O	A
		53S-W	F
17S-O [2]	B	53S-T	G
17S-T [2] [3]	H		
		61S-O	B
		61S-W	E
		61S-T	F

[1] For corresponding bend radii see table below.
[2] Alclad 17S and Alclad 24S can be bent over slightly smaller radii than the corresponding tempers of the uncoated alloy.
[3] Immediately after quenching, these alloys can be formed over appreciably smaller radii.

Radii Required for 90° Bend in Terms of Thickness, t

Bend Classification	Approximate Thickness: B&S Gauge 26, Inch 0.016, 1/64	20, 0.032, 1/32	14, 0.064, 1/16	8, 0.128, 1/8	5, 0.182, 3/16	2, 0.258, 1/4
A	0	0	0	0	0	0
B	0	0	0	0	0–1t	0–1t
C	0	0	0	0–1t	0–1t	½t–1½t
D	0	0	0–1t	½t–1½t	1t–2t	1½t–3t
E	0–1t	0–1t	½t–1½t	1t–2t	1½t–3t	2t–4t
F	0–1t	½t–1½t	1t–2t	1½t–3t	2t–4t	2t–4t
G	½t–1½t	1t–2t	1½t–3t	2t–4t	3t–5t	4t–6t
H	1t–2t	1½t–3t	2t–4t	3t–5t	4t–6t	4t–6t
J	1½t–3t	2t–4t	3t–5t	4t–6t	4t–6t	5t–7t
K	2t–4t	3t–5t	3t–5t	4t–6t	5t–7t	6t–10t

Handling and tool marks must be kept at a minimum to avoid expensive rejections and reworking. Care on the part of the individual workmen in handling the material is of highest importance. Partial protection is sometimes provided by painting the aluminum as early in the fabrication process as is feasible. The priming coat of paint can be used for

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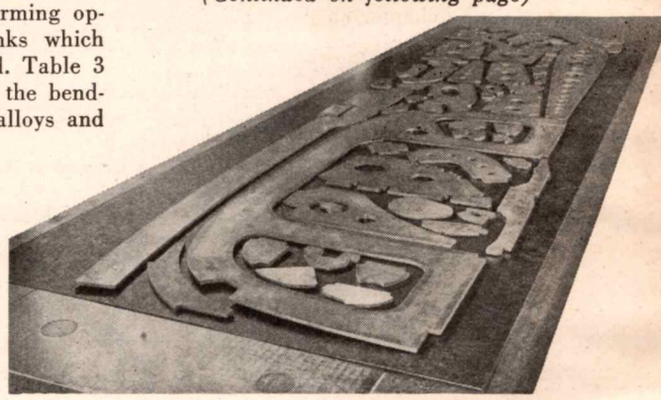
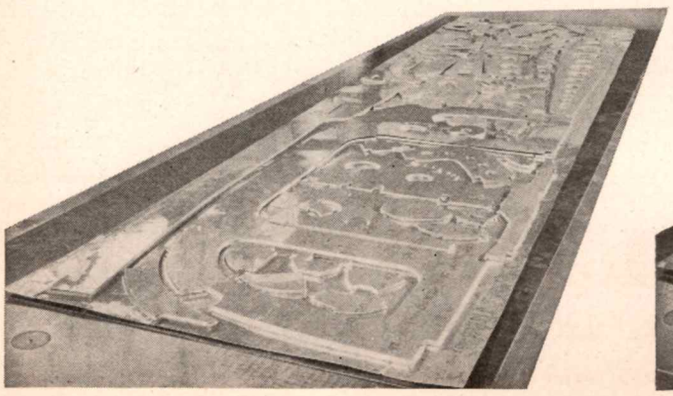
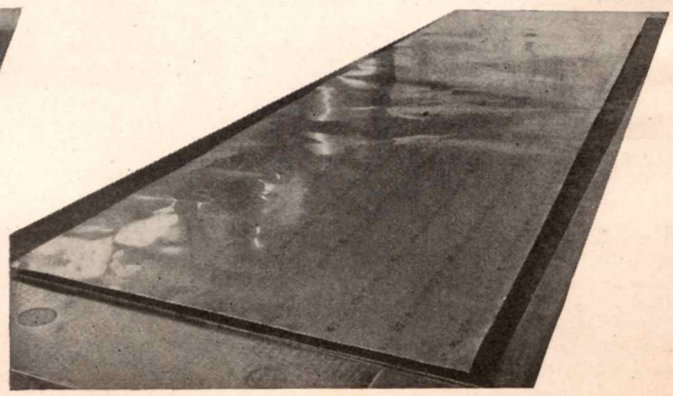
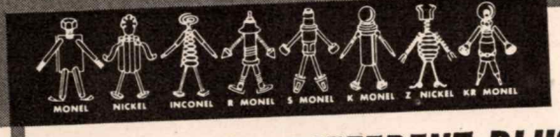


Rubber pad method for forming aluminum. Right—nesting of cutting blocks on gang plate arranged on pressing block; lower right—aluminum sheet in place over blocks; lower left—the finished work *(Douglas photos)*





8 STRONG, RUSTLESS *Metals*



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MONEL* 2/3 Nickel 1/3 Copper	GENERAL PURPOSE ALLOY Corrosion Resistance, Strength, Hardness, Toughness. Attractive Silvery White Color.	Annealed Hot-rolled Cold-drawn Cold-rolled, hard-temper	75 90 100 110	35 50 80 100	40 35 25 5	125 150 190 240	105 110 95
"R" MONEL* Contains the addition of .035% sulfur—	FREE CUTTING For High Speed Machining.	Hot-rolled Cold-drawn	85 90	45 75	35 25	145 180	96 99
"K" MONEL* Contains the addition of 2.75% Aluminum	EXTRA STRENGTH AND HARDNESS comparable to heat treated alloy steel. Heat Treatable. Non-magnetic.	Hot-rolled: As-rolled Hot-rolled: Heat-treated Cold-drawn: As-drawn Cold-drawn: Heat-treated	100 150 115 155	45 110 85 115	40 25 25 20	160 280 210 290	120+ 40 56 26
"KR" MONEL*	FREE CUTTING Extra Strength and Hardness. Heat Treatable. Non-magnetic.	Hot-rolled: As-rolled Hot-rolled: Heat-treated Cold-drawn: As-drawn Cold-drawn: Heat-treated	105 150 115 155	65 105 85 115	40 25 25 25	185 280 215 290	
"S" MONEL* Contains the addition of 4% silicon	EXTRA HARDNESS Non-galling.	Sand-cast: Annealed Sand-cast: As-cast Sand-cast: Heat-treated	90 130 130	70 100 100	3 2 2	275 320 350	
NICKEL 99.4% Nickel	CORROSION RESISTANCE Protection for Pure Products. Magnetic below 680° F. Good Electrical Conductivity.	Annealed Hot-rolled Cold-drawn Cold-rolled, hard-temper	70 75 95 105	20 25 70 95	40 40 25 5	100 110 170 210	120+ 120+ 120+
"Z" NICKEL* 98% Nickel	EXTRA STRENGTH AND HARDNESS Heat Treatable. Excellent Spring Properties. Good Electrical Conductivity. Magnetic.	Hot-rolled: As-rolled Hot-rolled: Heat-treated Cold-drawn: As-drawn Cold-drawn: Heat-treated	105 170 120 175	50 130 90 135	35 15 25 15	180 320 220 340	120+ 25 120+ 25
INCONEL* 80% Nickel 14% Chrome Balance—Iron	HEAT RESISTANCE Retains Strength. Resists Oxidation. High Corrosion Resistance.	Annealed Hot-rolled Cold-drawn Cold-rolled, hard-temper	85 100 115 135	35 60 90 110	45 35 20 5	150 180 200 260	120+ 110 85

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See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

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PURSUIT plane, combat plane, bomber, or peaceful airliner, all have their auspicious beginnings in the fire and thud of the powerful drop hammer. From the massive propeller hub, crankshaft and crankcase forgings to the tiny clevis forgings, wherever utmost strength and dependability with minimum weight are vital, there you will find the drop forging . . . more than likely produced on a Chambersburg hammer . . .

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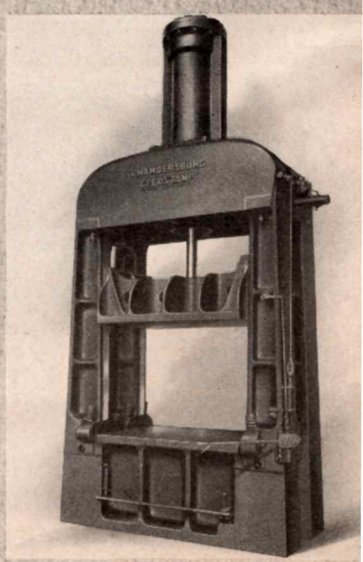

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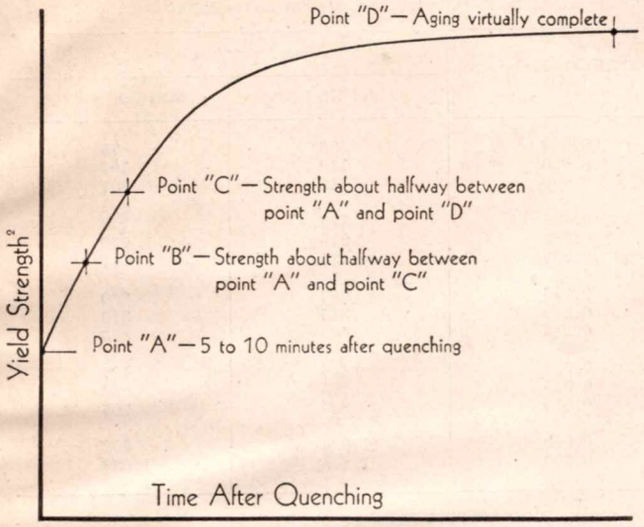
TABLE 4
Aging Data at Various Temperatures

Alloy	Yield Strength,[1] Lb./Sq. In. at Point "A"	Temperature of Metal				
		70°F.			32°F. [3]	
		Time to Reach Point			Time to Reach Point	
		B	C	D	B	C
17S	18,000	2 hr.	4 hr.	4 days	3½ days	.....
A17S	9,500	1½ hr.	6 hr.	4 days	.....	.....
24S[4]	.....	1 hr.	2 hr.	1 day	1 day	4 days
61S	9,000	2½ hr.	12 hr.	1 month	.....	.....

[1] Typical values.
[2] Ultimate tensile strength increases at approximately the same rate.
[3] When material is returned to room temperature, aging proceeds at normal rate.
[4] Alloy 24S shows no increase in strength in 7 days at a temperature of −108°F


Point "D"—Aging virtually complete
Point "C"—Strength about halfway between point "A" and point "D"
Point "B"—Strength about halfway between point "A" and point "C"
Point "A"—5 to 10 minutes after quenching
Yield Strength[2]
Time After Quenching

(Continued from preceding page)
this purpose or lacquer or varnish, either clear or pigmented, may also be used. These coats are often temporary in character and are removed from the exterior surfaces of the finished airplane. Heat treating, spot welding and anodic treating should be done on unpainted parts.

Heat Treatment

Heat treatment of aluminum[4] involves bringing the material to a prescribed temperature, holding it there for a prescribed length of time, and then *promptly* quenching it. The principal conditions necessary for correct heat treatment of various aluminum alloys used in aircraft are shown in Tables 1 and 2. Either a fused salt bath or an air furnace is used. Although most of the heat treatment in aircraft plants is confined to 24S and Alclad 24S sheet, directions are included for some other alloys. Table 1 indicates the temperature range for the various alloys, and Table 2 indicates the "soaking" period or the time the material is to be held within the prescribed temperature range.

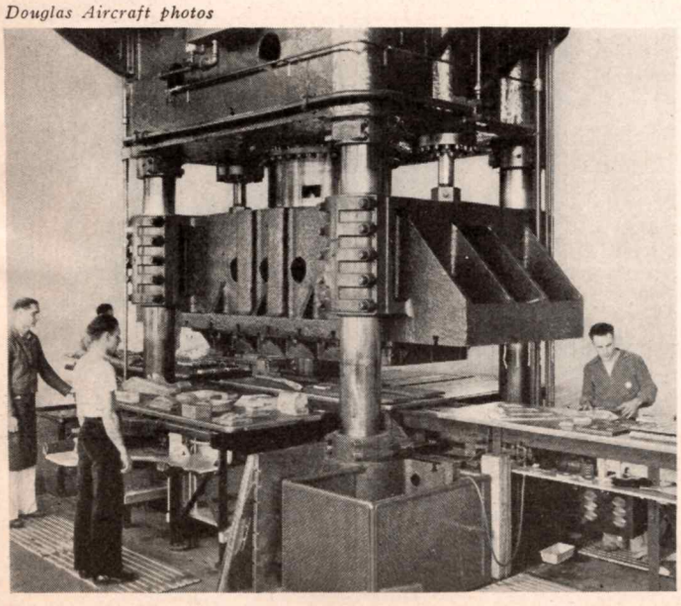
HEATING PROCEDURE AND CONTROL:—For air furnaces the tabular values are based on metal temperature as registered by a thermocouple attached to the part of the load that is thought to be the slowest to heat either because of its thickness or its location in the furnace. The soaking time is considered to start when the coldest part of the load has passed the lower limit of the heat-treating temperature range.

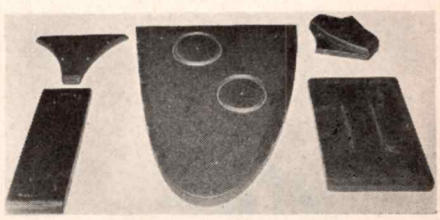
Since it is not practicable to attach a thermocouple to the load in a fused salt bath, the values in the tables are based on temperature of the bath. Soaking time starts when the bath temperature has reached the lower limit of the heat-treating range after the load has been immersed. When the weight of salt is large compared to that of the load (as is frequently the case with formed sheet parts), the bath temperature does not go below the minimum temperature for heat treatment, and the soaking time becomes the total time required in the bath.

It is important that the specified temperature limits be maintained. When the temperature is too low, optimum mechanical properties are not attained, and when it is too high, the quality of the material is impaired by melting at the grain boundaries. Heat-treating temperatures are specified as high as is considered safe in this latter respect. Thick material requires a longer soak than thin material, primarily because it has not been so thoroughly worked during the fabrication process.

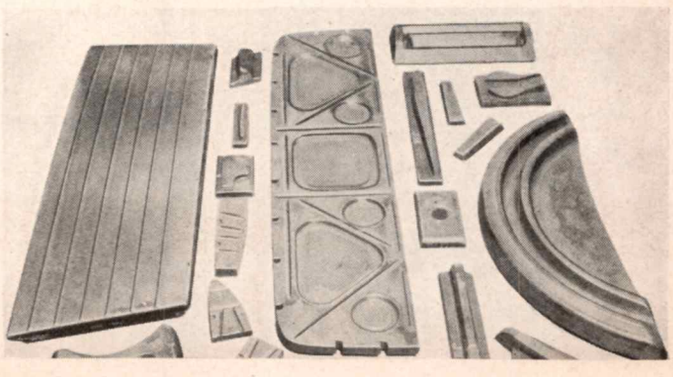
The soaking times shown in Table 2 are intended as a guide for a large variety of equipment and types of work. It is usually satisfactory to employ longer times, while shorter heating periods will often produce good results. In the case of Alclad sheet, diffusion of the alloying constituents of the core into the coating at heat-treating temperature tends to ad-

Douglas Aircraft photos





Tools for forming aluminum by the rubber pad method. Those at the right are made from synthetic material having a wood-fibre base, those below are metallic. At the left, a hydraulic press



See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

TABLE 5

Allowable Single Shear Strength of Aluminum Alloy Rivets

(Values from ANC-5—"Strength of Aircraft Elements," issued by Army-Navy-Civil Committee on Aircraft Requirements)

Rivet Alloy	Allowable Shear (Lb.) for Various Rivet Diameters							
	1/16"	3/32"	1/8"	5/32"	3/16"	1/4"	5/16"	3/8"
A17ST (F_{su} = 27,000 lb./sq. in.)	83	186	331	518	745	1,325	2,071	2,984
17ST (F_{su} = 30,000 lb./sq. in.)	92	206	368	573	828	1,472	2,300	3,313
24ST (F_{su} = 35,000 lb./sq. in.)	107	241	429	670	966	1,718	2,684	3,865

TABLE 6

Shear Strength [1] of Spot Welds

Minimum strength required for qualification under U. S. Army Air Corps Specification No. 20011-B. Single spot specimens tested in shear.

Metal Thickness,[2] Inches	Shear Strength in Pounds	
	Alclad 24S-T [3]	52S [4] and 61S [4]
0.012	80	75
0.016	110	105
0.020	140	137
0.024	175	170
0.028	214	200
0.030	235	217
0.035	290	260
0.040	345	310
0.045	405	365
0.050	465	427
0.065	705	632
0.070	800	705
0.080	1,025	852
0.090	1,265	1,000

[1] The tabular values are approximately 65 per cent of actual average results. The use of spacing less than eight times metal thickness or edge distance less than four times metal thickness will substantially decrease the strength of spot welds.

[2] When sheets of different thicknesses are joined, strength listed for thinner sheet applies.

[3] Values for Alclad 17S-T are 90 per cent of those for Alclad 24S-T.

[4] Any temper.

versely alter the composition of the coating material. This diffusion will lower the resistance to corrosion (especially in the case of thin sheet) if the total time at elevated temperature, including the heating period, is too long.

Heat treating bare 24S (not Alclad sheet) in an air furnace occasionally results in a roughened or minutely blistered surface. Moisture in the air is responsible for this condition, and it is aggravated by excessive periods of heating, particularly in humid weather. Coating the sheet with soluble oil before heat treating or the use of *Alorco* protective compound in the furnace will eliminate the trouble. The use of oil presents the possible hazard of an explosive mixture of oil vapors and air in the furnace. In addition to being safer, the protective compound is much easier to use since it is merely placed in the furnace with the load and decomposes when heated. The gaseous products of decomposition form a protective coating on the sheet.

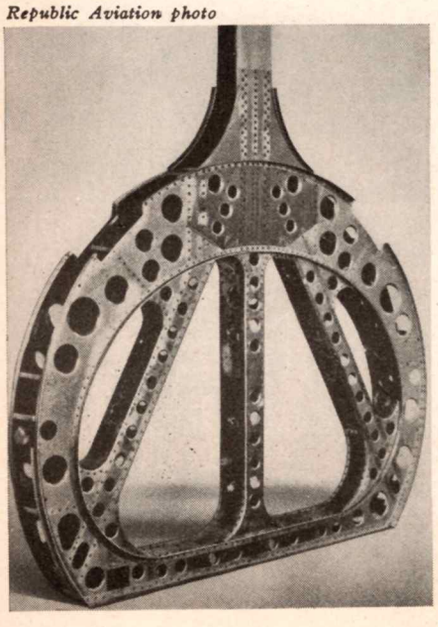
QUENCHING:—After removal from the heat-treating furnace or salt bath the material must be completely immersed in cold water with the least possible delay (a matter of a few seconds). A rapid cold water quench is essential to produce material with highest resistance to corrosion. The transfer to the quench tank should be made *quickly* in order that the material be quenched from a temperature as nearly within the heat-treating range as possible. Allowing the metal to cool slowly before quenching produces adverse effects similar to those resulting from using too low a heat-treating temperature. In the case of small loads or thin material the use of guard sheets is often advisable to prevent loss of heat during the transfer from furnace to quench tank.

Although 100°F is not the highest quenching-water temperature that will produce good resistance to corrosion, it is advisable and usually feasible to regard it as a maximum. Use of a large volume of water in the quench tank minimizes the increase in water temperature as each load is quenched. Continuous addition of cold running water will maintain the desired temperature and also tend to prevent the accumulation of salt in the water if the metal has been heated in a fused salt bath.

Because quenching in cold water has a tendency to warp the material, there is a constant effort to find a suitable quenching method that will not have this effect. Cold oil, boiling water, and sometimes an air blast are usually sufficient to produce specified minimum mechanical properties, but the resistance to corrosion is always impaired. In the case of 24S or 17S, this impairment is so serious that these milder quenches are not recommended, nor are they permitted by AN specifications. While the resistance to corrosion of Alclad 17S and Alclad 24S which has been slowly quenched (*e.g.* in warm water, oil or an air blast) is inferior to that resulting from rapid quenching, it is superior to that of bare 17S or 24S quenched in cold water under best commercial conditions. The foregoing statement presupposes that the alloying elements of the core have not diffused through the relatively

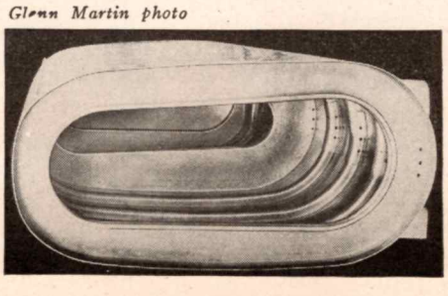
(Continued on following page)

Republic Aviation photo

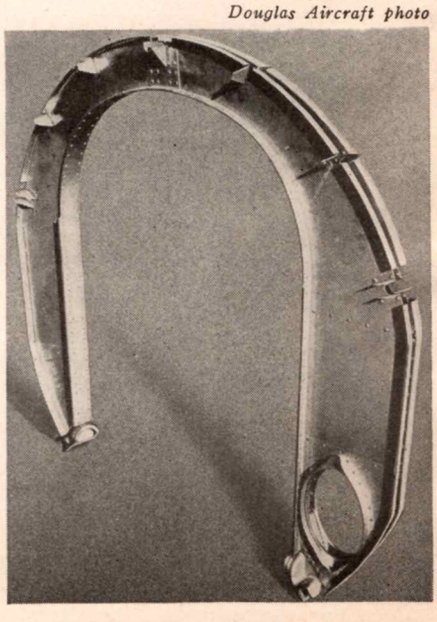


Right and left show examples of 24S and Alclad 24S parts formed from fully heat-treated stock aged at room temperature. Below is a spot welded Martin fuel tank

Glenn Martin photo



Douglas Aircraft photo



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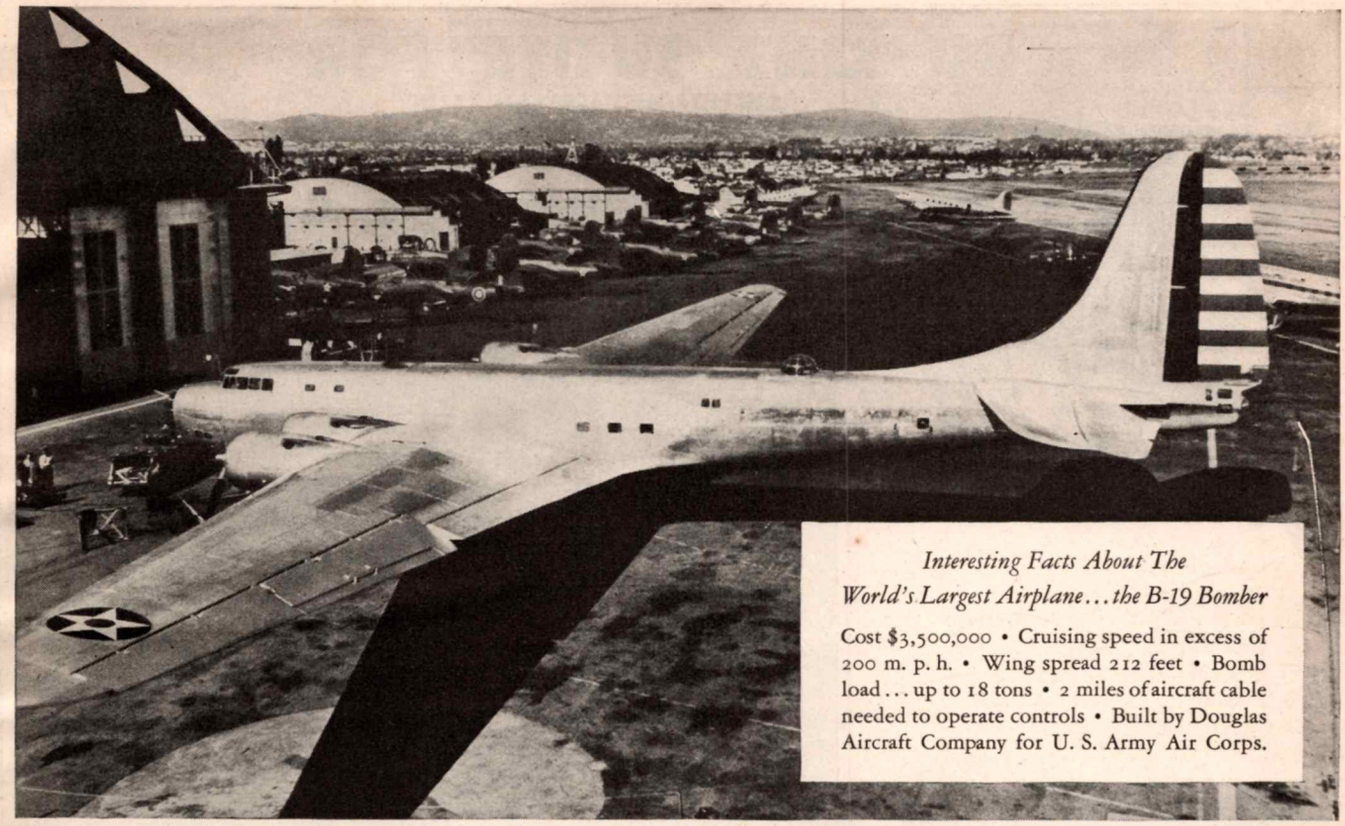


Interesting Facts About The World's Largest Airplane... the B-19 Bomber

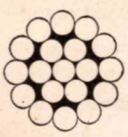
Cost $3,500,000 • Cruising speed in excess of 200 m. p. h. • Wing spread 212 feet • Bomb load... up to 18 tons • 2 miles of aircraft cable needed to operate controls • Built by Douglas Aircraft Company for U. S. Army Air Corps.

for the BIGGEST... *THE BEST!*

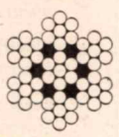
THERE'S never been anything like it before... tons of positive protection for U. S., hurtling through the air at 200 miles per hour plus, the biggest airplane ever built by man!

For this biggest of sky ships only the best of American products, the tested and proved, were used. Macwhyte feels justifiably proud that Douglas selected Macwhyte "Hi-Fatigue" PREformed Aircraft Cables to operate the B-19's controls (and that Macwhyte tie-rods and slings have also been used in the construction of this great ship).

The highest possible fatigue resistance is built into Macwhyte "Hi-Fatigue" Aircraft Cables. They are PREformed to make them easier to handle and give them a longer lease on service-life.



1 x 19 Semi-rigid is high in tensile strength. Specially made for bracing purposes. Unusually strong and dependable.



7 x 7 Flexible combines unusual strength with flexibility. Used on controls where abrasion is a factor but where extreme flexibility is not necessary.

7 x 19 Extra-Flexible is the finest of aircraft cables. Used extensively on all types of controls. Extreme flexibility makes it adaptable to any installation.

IMPORTANT FACTS ABOUT Macwhyte Aircraft Products

Like famous Macwhyte "Hi-Fatigue" PREformed Aircraft Cables, the following Macwhyte Products are also widely used by leading manufacturers of military, commercial and private planes:

AIRCRAFT SLINGS. Both standard wire rope and braided wire rope slings are available. They are made to your specifications to handle any load no matter how large or small.

TIE RODS. Streamline, Square, Round. Conform to all A-N specifications as do Macwhyte "Hi-Fatigue" Aircraft Cables.

"Safe-Lock" Terminals. Eye end. Turnbuckle end. Fork end. Stud end. Made from Stainless Steel. Supplied attached or separate, according to specifications.

For further information write the MACWHYTE COMPANY, 2907 Fourteenth Avenue, Kenosha, Wisconsin... manufacturers of "Hi-Fatigue" Aircraft Cable—"Safe-Lock" Cable Terminals—Aircraft Tie Rods—Braided Wire Rope Slings—Monel Metal and Stainless Steel Wire Rope—and Wire Rope for all requirements.

NO. 575-A

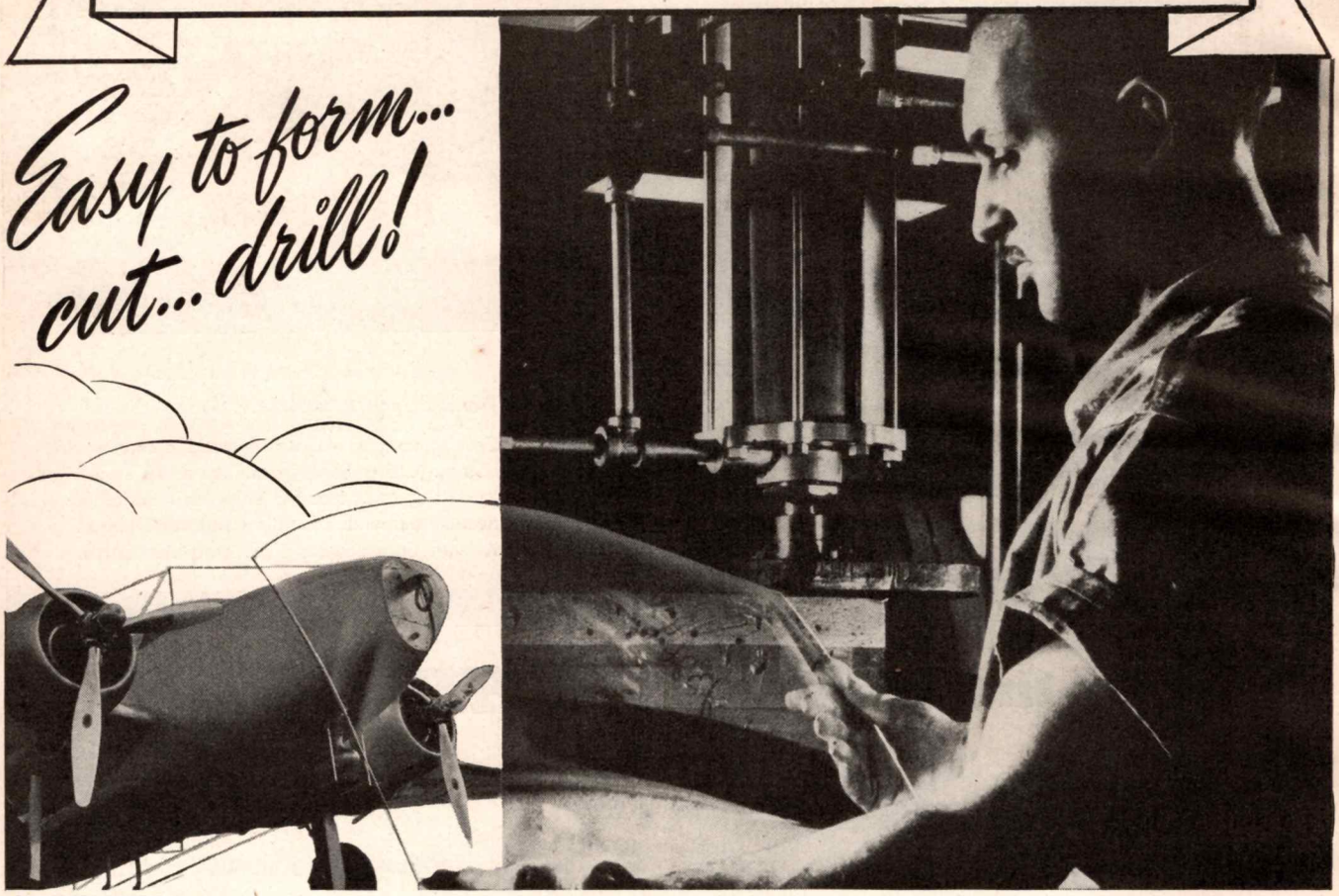
MACWHYTE *Hi-Fatigue* TRADE MARK REGISTERED **AIRCRAFT CABLES**

PREformed for Performance

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

DU PONT "LUCITE" FOR
METHYL METHACRYLATE RESIN
TRANSPARENT AIRPLANE SHEETING

Easy to form... cut... drill!



LOCKHEED LODESTAR

YOU can count on the *workability* of "Lucite" transparent airplane sheeting no matter how complicated your design requirements may be. This tough, crystal-clear plastic can be formed easily into deep compound curves. It is readily sawed, drilled and bevelled without the use of special equipment. Under proper treatment, it will not crack, nor lose its brilliant transparency.

These forming and machining qualities are of particular value in complicated, three-dimensional sections: transparent nose-pieces, blisters, cockpit enclosures, and offset windows for flush mounting.

"Lucite" is specified for many modern planes. It's used on the Lockheed Lodestar shown above. Strong, transparent, it minimizes working and forming time.

Du Pont "Lucite" methyl methacrylate resin is available in standard-sized sheets. Larger sheets can be made. Should any problem of design, forming or mounting arise, Du Pont technicians and their facilities are always at your disposal. E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Arlington, N. J., and 2419 S. Grand Ave., Los Angeles, Calif., 350 5th Ave., New York City, 1808 North American Building, Chicago, Illinois.

When you order acrylic transparent sheeting, specify Du Pont "Lucite"

"LUCITE" HAS MET AND FULLY PASSED GOVERNMENT SPECIFICATIONS

Advantages of "Lucite"

1. **Strength** (*tensile: 5,800—8,800 lbs. per sq. in.; flexural: 10,000—15,000 lbs. per sq. in.*)
2. **Lightness** (*specific gravity: 1.18—1.20*)
3. **Weather-resistance** (*3 years' exposure without apparent change*)
4. **Clarity** (*light transmission—visible range: 90—92%*)
5. **Ease of forming** (*intricate three-dimensional pieces*)
6. **Ease of machining** (*readily drilled, cut, sawed, beveled, etc.*)

DU PONT
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LUCITE
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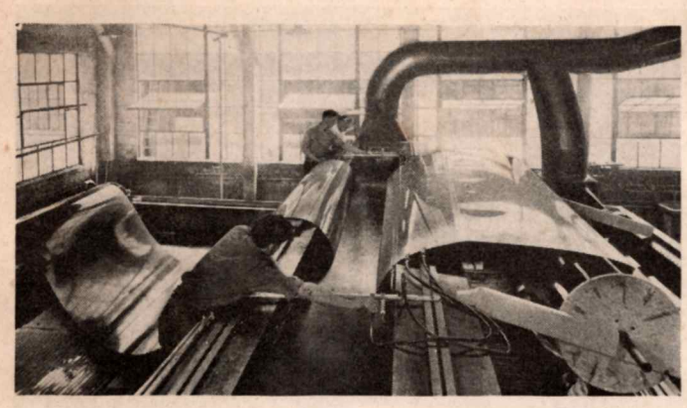
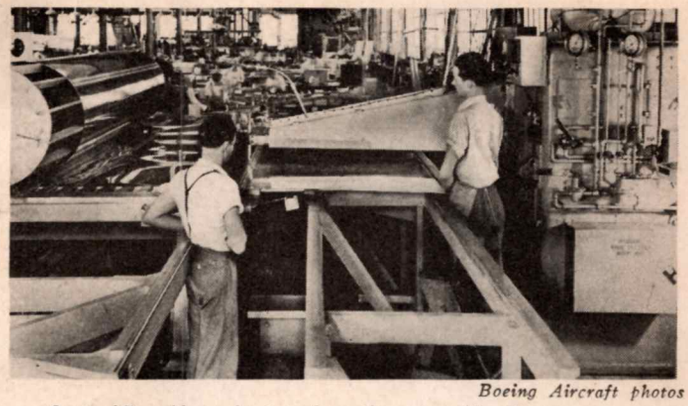
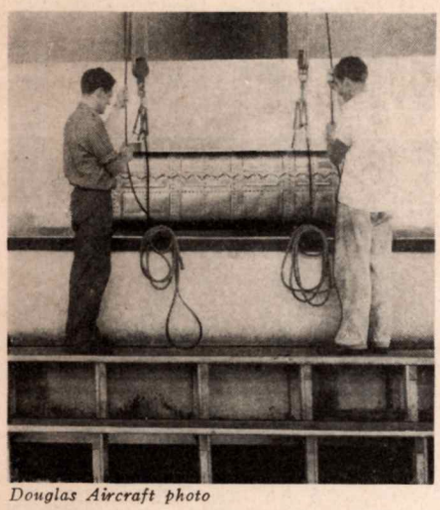


Anodically treating spot-welded aluminum alloy wing skin sheet



Boeing Aircraft photos

Spotwelding Alcoa sheet to form the outer skin of a transport



Douglas Aircraft photo

Applying the Alrok treatment to a fuel tank

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pure metal surface layers as a result of heating for too long a period. An alternative is to use 61S and 53S, when their strengths are adequate, since mild quenching has a negligible effect on the resistance to corrosion or mechanical properties of these two alloys.

RINSING:—In the case of salt-tank operation it is desirable to provide a rinse tank for removing excess salt which may adhere to the work. The tank should be of adequate size, and the rinse water should be hot, but not boiling. Rinsing is done promptly after quenching.

AGE HARDENING:—After quenching, the ultimate tensile and yield strengths of the material start to increase at a rate which is dependent on the alloy and the temperature. Table 4 shows how this aging progresses at room temperature for 24S, 17S and 61S. Lower temperatures will retard the rate of aging. In the case of 61S-W and 53S-W, higher temperatures are used to artificially age the material to the T temper (see Table 1). If it is desirable to maintain the workability to aid in forming, the material is held at a low temperature. This is commonly done with 17S and 24S rivets, and sometimes with sheet which is to be formed or with formed parts which are to be straightened after heat treating.

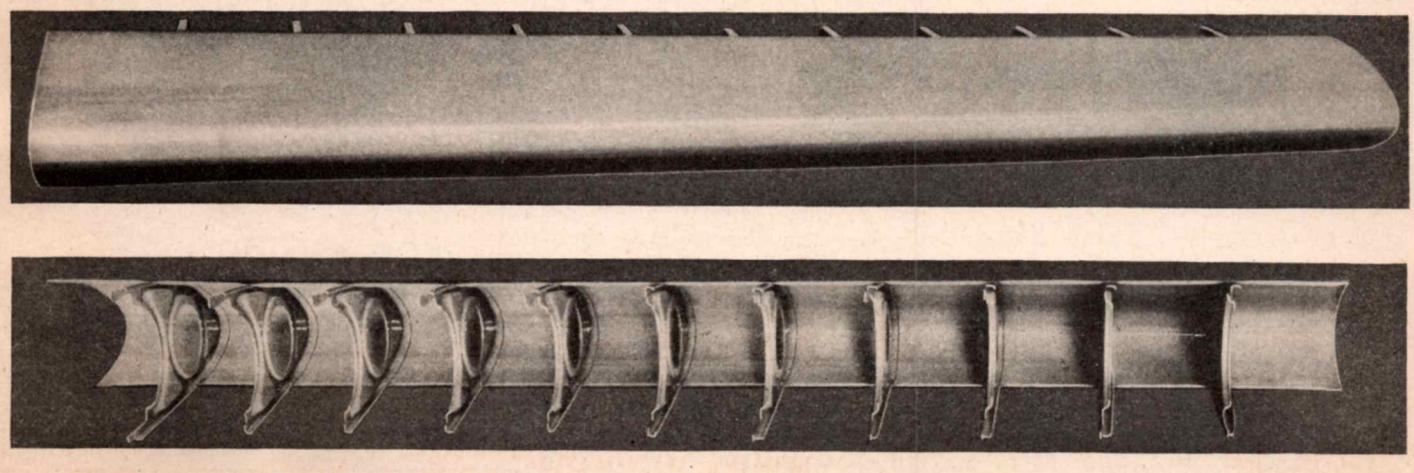
EQUIPMENT:—Requirements for the heating equipment are primarily uniformity and accuracy of temperature. Either a fused salt bath (usually sodium nitrate) or an air furnace can be used.

The salt bath has the advantage of rapid heating and generally more uniform temperature distribution, without forced circulation. The tank (usually cast iron) may be heated with gas or electricity. Sometimes the heat is applied directly to the bath with the so-called radiant tube gas or with electric immersion heaters. Some manufacturers use the salt itself as the resistor element, passing the current between electrodes which are immersed in the bath.

Air furnaces are perhaps more flexible in operation than fused salt baths, and avoid some of the hazards connected with the latter. It is frequently possible to arrange for more rapid quenching from air furnaces. They are usually electrically heated. Forced air circulation is beneficial in maintaining uniform temperature throughout the furnace and is necessary for rapid heating. Although manual control of temperature, based on indicating pyrometers, can be used, automatic control is far more satisfactory. Also, it is necessary to have recording devices to provide a permanent record of the time-temperature relations in the furnace.

Equipment should be provided to enable transfer of the load from the furnace to the quenching water in about 10 to 20 sec, depending on the size and character of the load. Purpose of this rapid transfer is to maintain the metal temperature until the instant sudden cooling starts. The quenching water must be kept clean and cool in order to obtain the best results.

As previously mentioned, when fused salt is used for heating it is usually necessary to provide a second water tank (at about 150°F) for dissolving off any salt that remains on the material after the quench. The warm water also facili-



Typical Vought-Sikorsky wing leading edge assembly, showing use of spot welding

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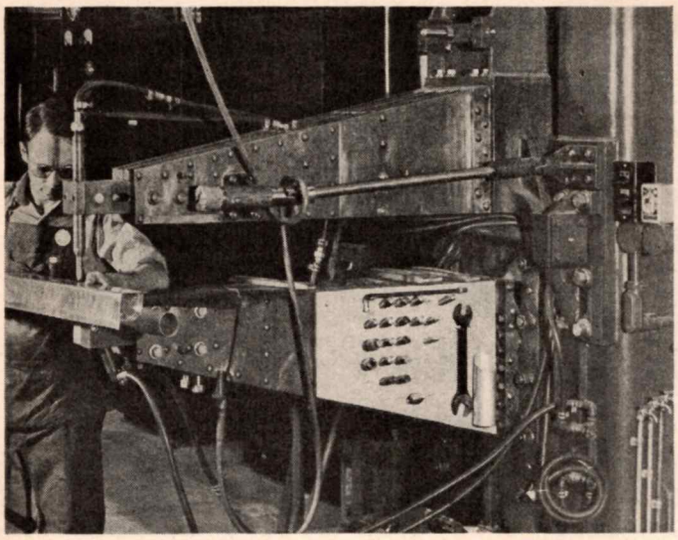
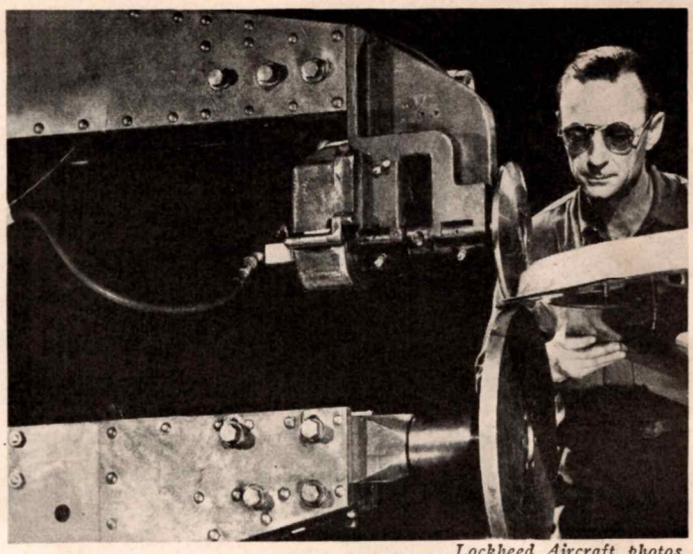




Lockheed Aircraft photos

Typical spot welding operation. Note spare electrodes. At the right the worker is seam welding an assembly

tates drying the parts.

HEAT TREATMENT OF RIVETS:—Heat treatment of rivets is best accomplished using equipment suitable for handling a large number of small parts. In air furnaces the rivets can be handled in small steel wire baskets.

Since anodically treated rivets should not be heated in direct contact with nitrates, closed-bottom steel tubes (not perforated) make convenient containers for use in salt-bath equipment. The tube should be only large enough to permit free dumping of the rivets so that heating will be rapid and uniform throughout the load. For such containers, 30 min is usually sufficient heating time. The top of the tube should be covered so that the load does not tend to cool off. The rivets should be at least 2″ or 3″ below the surface of the bath, and the tube should be immersed in the bath the greater part of its length.

Quenching is accomplished by dumping the rivets out of the container in which they were heated, into cold water. A wire basket or other perforated container submerged in the cold water, and into which the rivets are dumped, facilitates their removal.

Annealing

When annealed aircraft materials are required, they are normally bought in that condition from the metal manufacturer. However, it is sometimes necessary to anneal either heat-treated or cold-worked material.

In the latter case the material is annealed by bringing it to 650°F and then cooling at any convenient rate. Alloy 3S, however, because of its chemical composition, requires a temperature of 750°F.

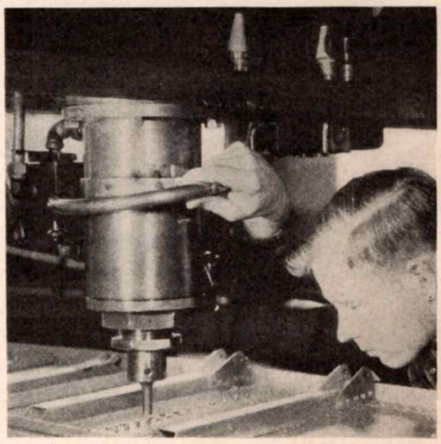
Heat-treatable alloys require special procedure to remove the effects of previous heat treatment and to avoid a heat-treating effect in annealing and cooling. If the material has not previously been heat treated, the above method is entirely satisfactory provided the temperature is not more than 660°F nor less than 630°F in any part of the load. When the material has been previously heat treated, this practice will anneal it to a large degree, but not completely. If complete softening is required the temperature must be 750° to 800°F. The metal is held at temperature for about 2 hr and then cooled not faster than 50°F per hour to 500°F, after which the cooling rate does not matter.

An air furnace is the most suitable equipment for annealing operations. If a nitrate bath is used, it should contain equal parts of sodium and potassium nitrates because of the lower freezing point of the mixture.

Machining

The equipment for machining aluminum alloys is generally similar to that used for other metals.[5] The cutting tools should be modified, however, in order to secure the best results. It is important to remember to grind more top and side rake on the cutting tools than is common for machining steel; to keep cutting edges sharp and free of burred or wire edges; and to maintain smooth, bright tool surfaces free from scratches.

The shapes of the tools used for aluminum are quite different from those used for brass, but approximate those for hard woods. After grinding to the desired shape, they should be finished on a fine abrasive wheel, followed by hand-



Squeeze riveting machine used at Consolidated

stoning or lapping.

Lathe tools are set considerably higher on the work than is the general practice with steel. Twist drills with large spiral angles are usually preferable. Saw and file selection is governed by the same principles as other cutting tools.

In general, best results are obtained by using comparatively high speeds and fine-to-medium feeds; the finer the feed, the higher the speed. Continuous and copious use of a lubricant is quite de-

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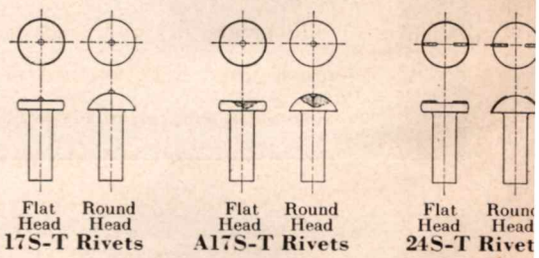

Identification marks for aircraft rivets

Cone-point and button riveteads resulting from various driving pressures. Tensile strength of each was within 5% of the strongest

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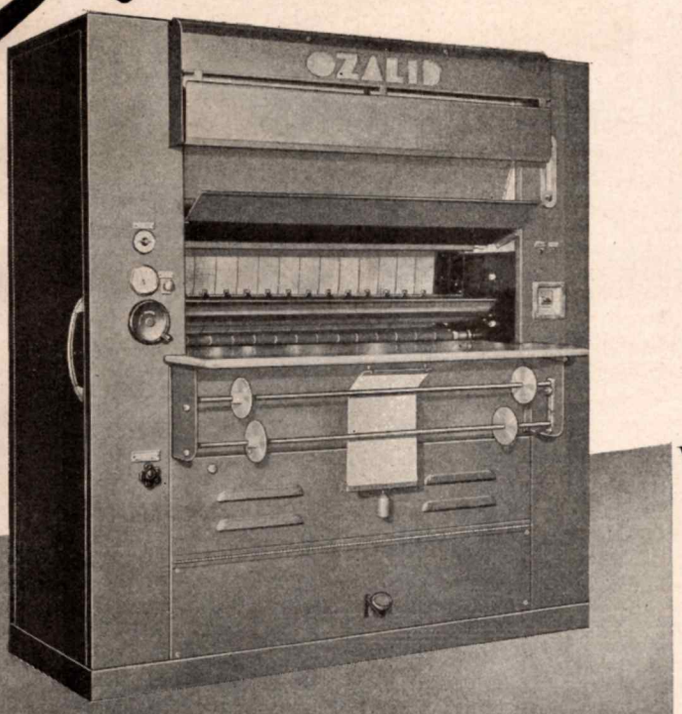
Announcing



THE NEW OZALID MODEL "B"

A WHITEPRINT MACHINE FOR *FASTER* PRINT MAKING

THE NEW Ozalid Model "B" Whiteprint Machine—with printing speeds up to 20 feet per minute—gives you *faster* print production in a medium priced machine . . . a machine designed to meet your demand for mass print production at an economical cost!

In the Model "B" has been incorporated the latest improvements in print making, combining exposure and dry development in one compact unit to turn out finished whiteprints, dry and ready for immediate use, in double quick time! Synchronized printing and developing, and automatic separation of print from original contribute to the speed with which the prints are turned out.

Distinctive features include a specially designed blower hook-up, enabling the operator to regulate the temperature of the printing cylinder. This permits the operator to print, with equal ease, the complete line of Ozalid materials from air mail weight paper to heavy acetate foil. There is also front or rear delivery of prints. A fluorescent light illuminates the front print delivery tray and feed board. This light also enables the operator to check prints for correct printing and developing when employing rear delivery.

The Model "B" uses Ozalid's complete line of standard sensitized materials, transparent materials and specialties, producing positive-type prints. Duplicate originals are made just as the whiteprints, requiring no extra equipment.

The machine allows the interchangeable use of cut sheets and continuous yardage. It occupies only 19 square feet of floor space—conveniently fits into any drafting room, plant or office—and requires but a single operator.

With this machine you get an economical, convenient and direct way of making positive-type whiteprints. Write today for detailed literature describing the new Ozalid Model "B"—the "fastest" word in dry developed print making!

OZALID PRODUCTS DIVISION
GENERAL ANILINE & FILM CORPORATION
JOHNSON CITY, N. Y.

Ozalid in Canada • HUGHES OWENS CO. LTD., Montreal

The essential margin of superiority that wins a war is necessarily the sum total of many component parts.

Value of the precise workmanship, long experience and unstinted care which the men of OHIO Seamless concentrate on the production of OHIO Quality Seamless Aircraft Tubing is best judged by performance of American built ships as they deliver their bomb loads - straight to the target.

Photo by courtesy of DOUGLAS AIRCRAFT COMPANY, INC., S B D Dive Bomber for U S. Navy and Marine Corps.

CHROME MOLYBDENUM FOR STRENGTH LIGHTNESS AND SAFETY

The OHIO SEAMLESS TUBE CO.

OHIO SPECIAL QUALITY

Thelby, OHIO

(Continued from preceding page)

sirable. For general use, a mixture of equal parts of kerosene and lard oil is satisfactory as a cutting compound. For milling, sawing and drilling, the more economical soluble cutting oils may be used.

Joining

Aircraft assembly involves a variety of methods. These include riveting, welding and the use of various screws and bolts. Although only the standard methods will be discussed here, there are many specialized procedures for us in inaccessible places and other applications.

RIVETING:—Riveting[6] is the most common method of assembling airframes. Standard rivet alloys are A17S-T, 17S-T and 24S-T, all of which are produced with several styles of heads identified by standard head markings. Brazier or mushroom heads are used for interior work, and sometimes for outside surfaces.

High-performance airplanes are usually flush-riveted on exposed surfaces with countersunk rivets. The type of countersinking ordinarily depends on the thickness of the part on the outside surface. The thicker parts are frequently machine countersunk, and thin stock is usually dimpled or embossed. Another method is to machine countersink the member being attached to the skin, and then emboss the skin sheet to form a recess for the rivethead in the outer surface of the sheet.

Head angles in common use on countersunk rivets vary from 78° to 115°. Since larger angles result in thinner heads, there is less tendency for the metal to be strained when the countersink is made by dimpling or embossing. Furthermore, a machined countersink can be used with thinner sheet.

So far only the preformed riveteads have been discussed. In hand driving aircraft rivets, it is almost universal practice to apply the blow to a set (flat-ended for flush rivets) which is held firmly against the preformed head of the rivet, thus pushing it into the hole and tending to keep it there while the heading is accomplished. A bucking bar or dolly having a flat face is held lightly (so as not to push the rivet out against the thrust from the driving side) against the point or end of the rivet shank. The inertia of this tool provides the force that upsets the rivet, forming a flat or pancake type head. It should be noted that the structure in which the rivet is being driven must deflect with each blow to provide the movement necessary for upsetting the rivet. A variety of pneumatic hammers, both slow and fast operating, are available for the hand driving of aircraft rivets.

Sub-assemblies are riveted wherever

(Continued on following page)

Why more ARCHITECTS and ENGINEERS buy Venus than any other 10¢ pencil

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Would you like samples of VENUS Drawing Pencils? Tell us what degrees.

VENUS *Drawing* PENCILS

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17 Degrees—9H to 6B. Also 3 Degrees for Tracing and Direct Pencil Blueprints.

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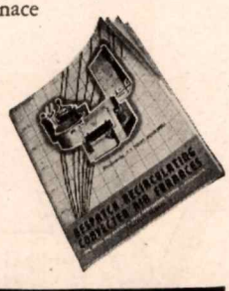
possible in fixed riveting equipment, which may be either of the single-stroke squeeze type or of the slow-operating hammer type. This method is considerably cheaper than the hand method, and usually produces a higher percentage of satisfactory rivets.

Rivets of A17S-T alloy are more widely used than those of 17S-T or 24S-T, and are regularly driven in the fully heat-treated and aged condition. Joints requiring greater strength are made with 17S-T or 24S-T rivets (see Table 5). Rivets of both of these alloys are usually reheat treated so that they can be driven before age heardening has progressed far (although it is possible to head the smaller sizes of fully aged 17S-T rivets). Satisfactory driving characteristics are maintained at room temperature (70°F) for about an hour after quenching in the case of 17S-T and for about 10 min in the case of 24S-T. To avoid the necessity for continually heat treating fresh material, 17S-T rivets may be driven after about 24 hr if they are held at the temperature of melting ice (32°F). Lower temperatures will retard age hardening still longer. In the case of 24S-T rivets a lower temperature is recommended. Packing in dry ice (CO_2) is satisfactory. When the rivets are returned to room temperature age hardening proceeds in the normal manner.

Despatch Intermittant Conveyor type furnace in use at Packard plant for insert shrinking of valve guides and spark plugs. This furnace is designed to accommodate a net load of 540 pounds. Processing time is one hour.

Despatch Monorail Loaded furnace in use at Packard plant for pre-heating of motor assemblies prior to hot glycol test for leaks. Furnace is designed to accommodate six motor heads and blocks per hour.

Wherever accurate heat control and work chamber uniformity are necessary, Despatch furnaces are recommended. Despatch Convected Air furnace design and construction with the use of ample heat and the larger Despatch fan attains a high degree of furnace efficiency in the temperature range 275°F to 1250°F. This is turned into production efficiency for all metals and alloys fabricators. Despatch furnaces are speedy—accurate—uniform and economical to operate. They are used for heat treating aluminum and magnesium castings, sheets and shapes, annealing brass, heating aluminum forging billets and rivets, tempering and drawing steel, stress relieving castings and welded parts. Call upon a Despatch engineer for the proper furnace design.



Write for Bulletin No. 81M. It illustrates Despatch furnace features; pictures installations for every type of material handling and heat treating process.

DESPATCH OVEN COMPANY
MINNEAPOLIS MINNESOTA

Inspection of Rivets

INSPECTION OF DRIVEN RIVETS:—The standards to which driven rivets should conform are frequently uncertain. In addition to dimensions (thickness, diameter) and perfection of shape, inspection is concerned with whether the driven head is co-axial with the shank (not "clinched") and whether the metal is in a sound condition (not badly cracked). Cracking at the edge of the head frequently results from overdriving or from driving rivets that have undergone too much age hardening. However, it has been determined that even badly cracked heads are strong enough to develop the full shear and tensile strength of the shank. The series of rivetheads shown in an accompanying illustration was tested in tension to determine how well formed a head had to be in order to develop full strength. The tensile strengths of all of the rivets shown were within 5% of the strongest one. The foregoing is presented for the purpose of indicating that superficial cracks in rivetheads and minor deviations from the theoretically desired shape of head are not cause for concern or replacement. The second rivet that is driven in any one hole is likely to be even more defective than the first, because the hole will be enlarged, and the rivet will be more likely to buckle and form an imperfect head.

Electric-Resistance Welding

ELECTRIC-RESISTANCE WELDING:—Electric-resistance spot and seam welding[7] is economical and often results in smoother surfaces than riveting. When a machine can be operated a large part of the time, the higher cost of the equipment compared to that for riveting is often offset by the lower unit cost of spot welds. In spot welding, the design of the parts and their sequence of assembly must be arranged to provide the necessary access for the arms of the welder and the welding electrodes. Special electrodes and electrode holders are frequently used for joints that cannot be reached with standard equipment.

The spot-welding process is ideal for the fabrication of sub-assemblies which are small enough to be easily handled by one or two operators. It is in this field that spot welding is finding much favor in the industry.

Both the U. S. Army and Navy approve the use of spot welding, but require qualifying tests on each welding machine for each gauge and alloy that is to be used. The shear strengths required by the U. S. Army are shown in Table 6. In setting up a machine for a

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given job, it is customary to make several test welds in scrap strips of the same gauge, alloy and temper as the work itself. These set-up welds are tested by peeling or rolling the sheets apart so that a good spot weld will pull a "button" out of one of the sheets. These buttons should be nearly round and of a diameter about equal to twice the sheet thickness plus 0.060″.

Torch Welding

TORCH WELDING:—The use of torch welding in aircraft is limited to applications where high unit stresses are not involved. Its chief merit is that it is the simplest way to obtain the gas- or liquid-tight seams required in fuel and other tanks.

The heat of welding anneals a strip of metal on either side of the joint in the case of strain-hardened alloys and seriously affects the heat treatment in the case of heat-treated alloys. For this reason torch welding is almost completely confined to the alloys which are not heat treated. These alloys, especially 2S and 3S, are well suited to welded construction.

Standard welding equipment is suitable for aluminum. Special flux (such as Alcoa No. 22 Torch Welding Flux) and suitable filler material (either 2S wire or 43S wire containing 5% silicon) are necessary. Acetylene gas is most commonly used for welding aluminum, especially when the operators are accustomed to using it for other metals. However, in some cases hydrogen gas will be more satisfactory.

Since the welding flux is corrosive, it must be completely removed after the weld is made. The use of warm water and a brush or cloth does a fair job when there is easy access to both sides of the weld. It is best practice, however, to follow this type of cleaning with a dip in a 5% sulfuric acid solution at a temperature of about 150°F for 10 min. If it is more convenient to use the dip at room temperature the concentration should be increased to about 10% and the time to 30 min.

Protective Finishing

Government specifications of the U. S. Army, Navy and Civil Aeronautics Administration cover the general requirements for aircraft protective finishes. Details are usually covered in each individual contract, as there are often special procedures required by construction methods or the particular service for which the aircraft are intended. The extent of the protection that is needed depends on the inherent resistance to corrosion of the materials, the environment in which the aircraft is to be used, and to some extent on the completeness and frequency of the cleaning and maintenance practices used.

Alclad sheet on the outside surface of commercial transports and U. S. Army aircraft is customarily left bare except for insignia, or where camouflage paint is applied. The inside surface of the same sheet is frequently given one or more coats of paint applied after assembly. In the case of commercial transports the shop coats intended to minimize scratching and marring are simply left intact on the inside surface. The extruded stringers in the same airplane (which are not Alclad) may be given an anodic oxide treatment before painting which provides still better protection than the paint alone.

Naval aircraft are given a complete protective finish because they generally operate under severe corrosive conditions. Recently, there has been more tendency to place reliance on the ability of Alclad sheet to maintain its appearance and structural integrity without protective painting. Pan American Airways' Boeing Clippers furnish a striking example. Paint was removed from the outside of the hulls, leaving the anodically treated Alclad 24S-T sheet exposed to the elements. This move was based on the results of extensive tests and service trials. *(Continued on following page)*

THAT EXTRA SOMETHING

Precision performance marks a champion of the ski-ways. And precision performance has made Dumore motors the champions of extra "Power Hours." On business machines . . . surgical and scientific instruments . . . household appliances . . . electric tools . . . delicate aircraft controls . . . wherever packaged power is needed for maximum performance with minimum size and weight, you'll find Dumore fractional horsepower motors setting records. Why not put a champion to work on your own power problem? A letter to Dumore engineers gets the right answer. There's no obligation.

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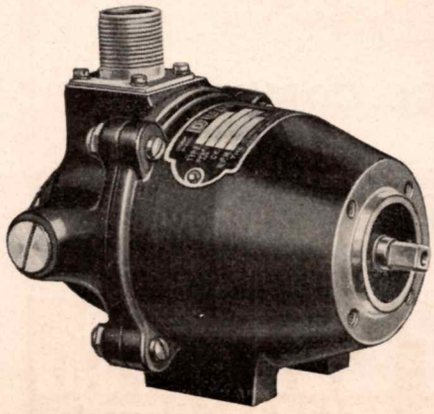

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MOTORS

SPECIFICATIONS FOR TYPE E2X MOTOR
Voltage, 12 or 24; h.p. output, 1/30; r.p.m., 7500; continuous duty; explosion-proof; varying speed; weight, 2 lbs. 2 oz., bearings, grease-sealed ball. Conforms to Air Corps specifications.

For EXTRA Power Hours

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

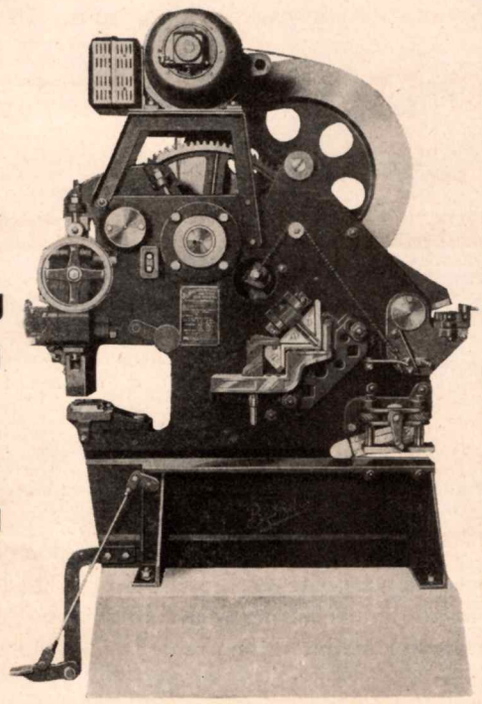
(Continued from preceding page)

Slowly quenched Alclad sheet is not so resistant to corrosion as material rapidly quenched in cold water. Therefore, Alclad sheet that is not cold-water-quenched should, when intended for use under severe corrosive conditions, receive the same general protective finish employed on plain 24S-T or 17S-T parts.

The fundamental principle of corrosion protection is that *dry aluminum cannot corrode.* Aircraft structures are designed to drain freely and provide ready accessibility of all parts for cleaning, repainting, repair and inspection. Joints and crevices which invite the entrapment of moisture are eliminated as far as possible or are suitably sealed. Measures are taken to insulate dissimilar metals from adjacent aluminum alloy by painting the faying surfaces before assembly and inserting nonhygroscopic gaskets.

In using many of the protective finish systems required, it will be necessary to apply anodic treatments to aluminum alloy parts. These treatments produce artificial oxide coatings on the surface of parts so treated. The results of these treatments are to enhance the inherent resistance to corrosion of the aluminum alloy and to provide for best paint adherence, particularly under severe corrosive conditions. Anodic treatments applicable to aircraft are described in U. S. Army Air Corps and Navy Department specifications. In general, the treatments consist of making the aluminum alloy parts the anode of an electrolytic cell in which the electrolyte is either chromic acid or sulfuric acid, with the chromic acid process being the one most generally used in the industry. Oxide films may be produced by *Alumilite* process patented by AluminumCompany of America. Less expensive than anodic treatments are the chemical-dip treatments. Another type of chemical treatment involves a 5-min dip in a 5% chromic-acid bath at 140°F. Certain of these treatments provide resistance to corrosion and paint adherence only slightly less effective than do the anodic treatments. The processes are approved by the Army Air Corps under certain conditions.

Production Tie-ups Can't Happen Here!



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UNIVERSAL IRON WORKERS

REFERENCES

(1) *The Use of Rubber for Producing Sheet Metal Parts.* Stanley Kogut and Chris Frey. AERO DIGEST; Nov. & Dec., 1940 and Jan. 1941.
(2) *Machining Aluminum,* published by Aluminum Company of America.
(3) *Job-Lot Aircraft Stampings,* The Iron Age, Oct. 19 and 26, 1939.
(4) *Shop Instructions for Heat Treatment of Alcoa Aluminum Alloys 17S and 24S,* published by Aluminum Company of America.
(5) *Machining Aluminum,* published by Aluminum Company of America.
(6) *Riveting Aluminum,* published by Aluminum Company of America.
(7) *Welding Aluminum,* published by Aluminum Company of America.

VULTEE FLIGHT TESTING

(Continued from page 167)

Wing flap operation is now checked, and flaps are extended at airspeeds from 90 to 100 mph to check for stiffness or binding. Other items checked while cruising are the flight instruments and alternate power sources.

The directional and artificial horizon gyro instruments are checked carefully for proper operation, which includes the caging and uncaging, any sluggishness which might be present, and normal operation through their range of action.

The compass and compass card are checked for proper compensation. The directional gyro is checked with the compass. The bank and turn restriction valve is adjusted so that one width of the turn hand results in a 360° turn in 2 min.

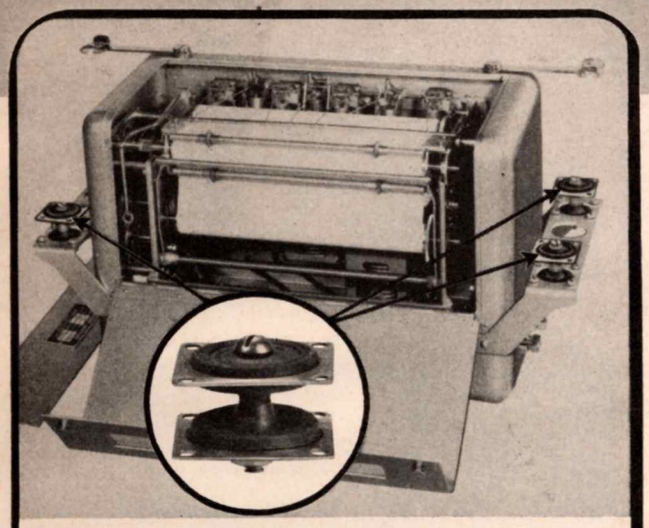
Altimeter, airspeed indicator, rate of climb, and chronometer instrument indications are noted. The airspeed indicator is also tested on the alternate sources of static pressure.

Hot and cold air valves are operated to determine their normal operation and flow of air. The test pilot then proceeds to check miscellaneous equipment, such as extra radio coils, flight and engine operation data cards, *etc.*

Information obtained on the initial flight is written either in blue or red pencil, on flight check sheets, during the course of the test flight. Blue penciled notations denote routine check and satisfactory operation. The red pencil is used for items which require correction by ground crews before final flight.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

FLEXIBLE SUSPENSION *makes possible Vibration-Free recording of flight data*



Lord Plate Form Mountings in series give freedom of motion in all directions and thus completely isolate Friez Flight Analyzers from surrounding vibration and landing shock.

THE efficiency with which any flexible mounting isolates vibration is a function of the deflection of the mounting when loaded. Lord Bonded Rubber Mountings when properly installed are usually soft in the direction of the vibratory thrusts and deflect freely in shear under load. Their ability to protect sensitive aircraft instruments from vibration is well typified by their installation in series on the Friez Flight Analyzer, illustrated at the left. The multiple flight data is recorded faithfully by this instrument without peaks or valleys resulting from vibration. In many cases a single mounting is used at each mounting point for efficient isolation.

Various styles of Lord Shear Type mountings are widely used for flexibly suspending engines, instrument panels, radios and other equipment. Lord has specialists in the control of aircraft vibration who are available for working on your engineering problems.

BONDED RUBBER SHEAR TYPE MOUNTINGS
For Engines, Cowls, Instrument Panels, Radios, etc. . . . Dynafocal Suspension For Radial Engines

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IT TAKES RUBBER IN SHEAR TO ABSORB VIBRATION

Stars indicate approximate locations of employers of Aero I.T.I. graduates

Now 137 FIRMS in the Aviation Industry Employ 3,416 Aero I. T. I. Trained Men

These figures are submitted to the Aviation industry as an indication of the marked success of Aero Industries Technical Institute in meeting the industry's rigid personnel requirements. The 3,416 graduates were placed with the 137 firms in only 43 months' time—which is believed to be a record for an aviation school providing comprehensive vocational training in aircraft production and airplane and engine maintenance, and true professional training in aeronautical engineering.

ONLY ONE YEAR AGO

71 FIRMS in the Aviation Industry Employ Aero ITI-Trained

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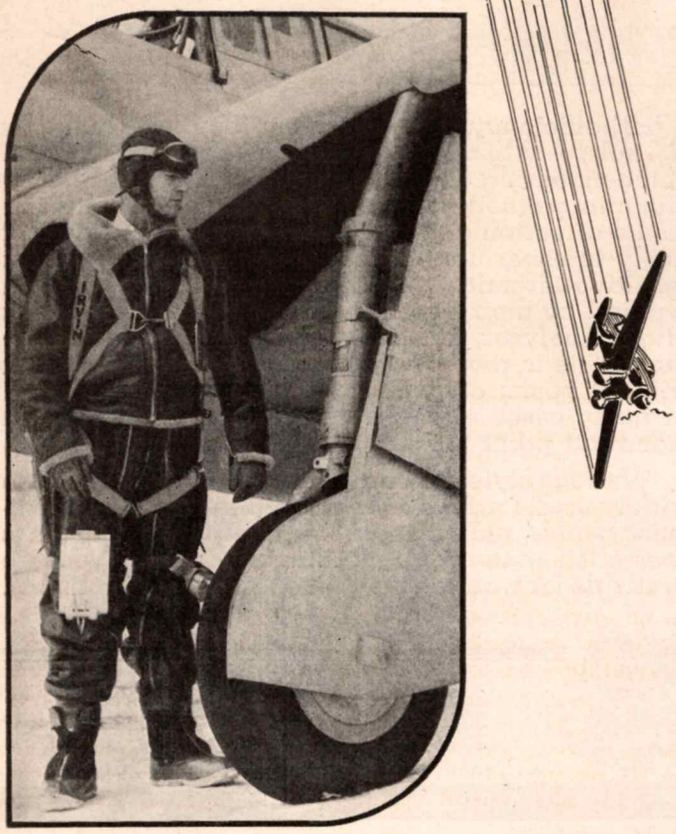

In a recent "all out" power dive Curtiss' test pilot, Lloyd Child, saw the needle run off the chart—of course he uses an IRVIN CHUTE.

• •

Standard equipment for British Air Ministry and over 40 other government air forces.

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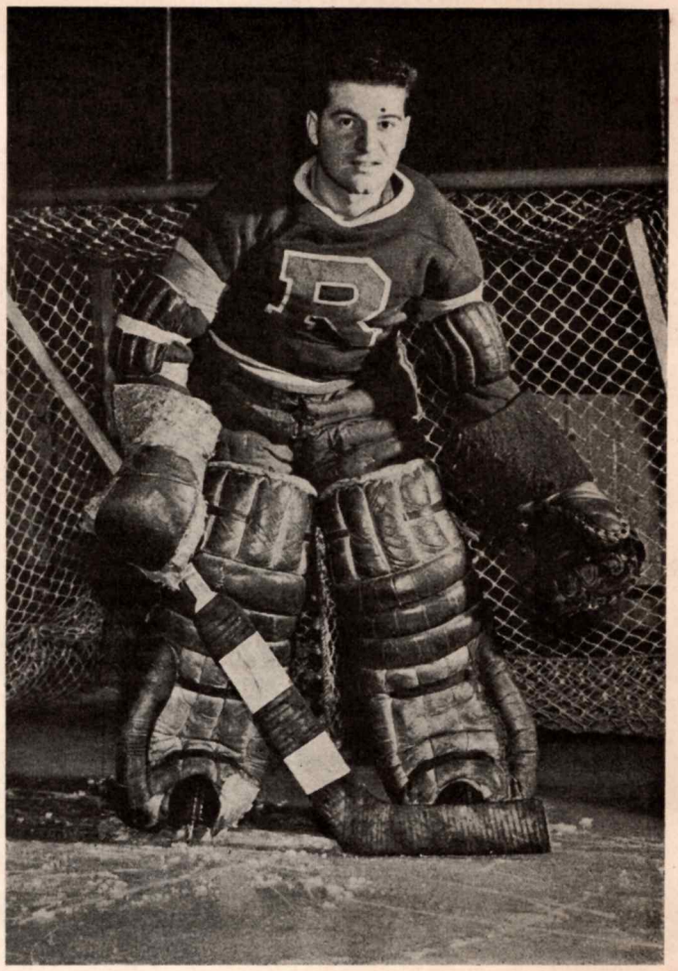

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See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

WASHINGTONIA

(Continued from page 50)

SPAB action occurred concurrently with the word from Col. John H. Jouett, president, Aeronautical Chamber of Commerce, that during the first seven months of 1941 American manufacturers delivered to Great Britain nearly twice as many combat planes as the British admit they lost during the whole of 1940. In pointing out that American manufacturers gave Britain in excess of $284,000,000 worth of planes, engines and parts, Col. Jouett also made clear that this huge quantity of material was not mentioned in the lease-lend report. Lease-lend accounting revealed $6,000,000 worth.

The SPAB statement suggested the airlines this year have received only 40 planes. The new program, beginning in 1942, permits airlines tentatively to obtain 156 DC-3s, 20 DC-4s, and 52 Lockheed Lodestars. SPAB made clear the new planes are to be built with reinforced flooring and wider doors, making them quickly convertible into troop transports, each capable of carrying 30 soldiers with full equipment.

☆

Contracts for various aeronautical products and purposes made by Government agencies the past month, chiefly by the Army, total $145,349,353. The total includes items such as the new plant authorized for the Bell Aircraft Corp. near Wheatfield, N. Y.; the new General Motors Corp. aircraft plant at Bristol, Conn.; and the expansion of the General Motors plants at Vandalia, and at Moraine, both in Ohio. It includes also the $64,000,000 contract for planes and parts given to the Republic Aviation Corp., and the contract made by Undersecretary of War Patterson with Transcontinental & Western Air, Inc., for training crews of the U. S. Army Air Corps Ferry Command. The five-man crew, pilot, co-pilot, navigator, flight engineer, radio operator, will be trained at TWA Civilian Flying School at Albuquerque, N. M., for a month. Ten crews will be trained each month until Spring, 1942. Atfero, the Canadian corporation controlled by Canadian National Railways, has been training its RAF flyers at the same general center. The British part of the training service has lately been taken over entirely by the RAF.

☆

HR 5788, supplemental appropriation bill to be enacted shortly, includes $685,000,000 for aircraft and parts and services for lease-lend purposes; $16,207,500 to be expended on the Ames Aeronautical Laboratory at Moffett Field, Calif., and $1,162,575 for the NACA, to be expended on various experiments. In the House, also, the Nichols Committee studying air crashes, recommended: clear-vision devices for aircraft windshields; better weather observation and forecasting; better lighting systems for all airports; substantial increase in CAA airport and air carrier inspectors; certification of airport control tower communication equipment by CAA; and not less than one member on every shift in airport control towers to be employed by the Air Traffic Control Division of the CAA.

Acme photo

Assembling steel runway at Marston, N. C., during First Army maneuvers

☆

Army Air Corps, during the next year, is expected to employ 200,000 civilians, more civilian personnel than any other branch of the Government, military or civil. Most of them will be employed for skilled and specialist jobs.

Recently, 90 Air Corps officers were promoted from the rank of major to temporary rank of lieutenant-colonel, the promotions being made to remove the inequalities between officers of the Regular Army and the Reserve Corps. The officers receiving promotion had been in the commissioned forces of the Regular Army either 22 or 23 years. Approximately 3700 officers of both Regular Army and Reserve Corps, from second lieutenants to lieutenant-colonels, will receive temporary promotions, the larger number to be members of the Officers' Reserve Corps.

☆

Manganese, badly needed in the industry, is expected to be more plentiful. For some months the U. S. Bureau of Mines has been exploring resources in Nevada and Arizona. Vast beds were found in these areas, but it was not known if they could be transformed into commercial metal. The Mines people built a pilot plant at Las Vegas, and with power from Boulder Dam they demonstrated conclusively that the ore can be refined practically to produce a large quantity of the material. The commercial plants are now in operation. Other operations are expected to produce manganese in other Western States.

Over 30 different plants of varying sizes are rapidly to be put into operation on the West Coast to produce steel, a large part designed for the aircraft industry which is expected to expand out there. In the Grand Coulee Dam area around Seattle, Spokane and other Washington and Oregon sections, and in Southern California around Los Angeles, the Government has brought in, and is rapidly bringing in more plants for the production of alumina as well as for the manufacture of alumina into aluminum in the various forms which are needed for the aircraft industry. This is programmed to reduce the time wasted in transporting raw materials from point of origin, and manufactured materials back from the East to the West. Several other light metals required in aircraft also are in process of production in the West. Apparently the aircraft industry is the magnet which is building up a vast basic industry of metals and manufacturing on the West slope that would not have come about for another decade.

☆

Portable airfields are reported completely successful by the U. S. Corps of Engineers. They were planned and built at Ft. Belvoir, Va., near the Capital, and tested and developed by 21st Engineers at Langley Field, Va. The runways were used in the Louisiana and South Carolina maneuvers. They consist of corrugated steel strips, 16″ wide, ⅛″ thick, and 10′ long. The strips are locked together to form a runway 150 ft wide and 3000 ft long, weighing approximately 1000 tons. The fastest and largest planes were able to take off and land.

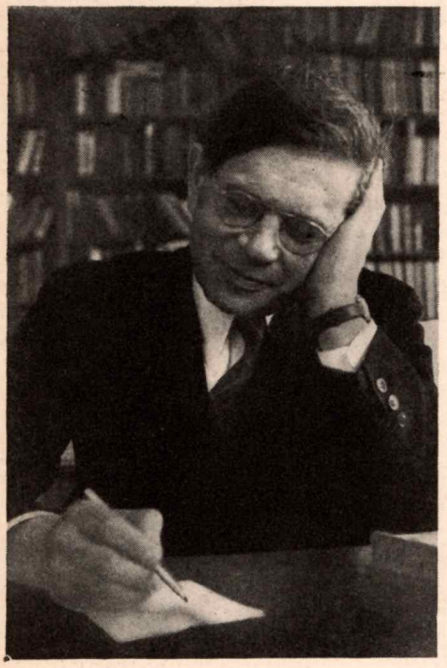
The runways are easily camouflaged, and are especially useful on sandy soil and similar soft topography. Hummocks and bumps are leveled by bulldozers. Vents are made in the steel for grass tufts. The ready-to-use material and accessory equipment may be transported in 15 to 20 freight cars.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

AERO Equipment Digest

SERVICE GUIDE TO NEW DEVELOPMENTS IN ACCESSORIES
SHOP EQUIPMENT • PARTS • MATERIALS • METHODS

Catalogs or other available literature concerning the items described in AERO *Equipment Digest* may be obtained through the service coupon below. Indicate by its key number the item you are interested in. If special information is required, write the manufacturer direct, mentioning the key number shown at the beginning of the item.



Dr. Alexander Klemin who will conduct this department beginning with the next issue

DR. ALEXANDER KLEMIN
Consulting Editor

PRACTICALLY every branch of Industry contributes an important share to the phenomenal developments of the American aircraft industry. The aircraft manufacturer, the operator, engineer, mechanic and others, already working under tremendous pressure, must add to their tasks by keeping abreast of new equipment, learning its principles, its possibilities and merits. Only thus can the products of American ingenuity be made to serve the increasing needs of the aircraft industry in its efforts to achieve even higher speed for greater mass production.

The presentation of accurate, unbiased data on aviation and allied equipment is therefore more important than ever before. For the past 10 years AERO DIGEST *has published increasing numbers of items in its New Equipment and Trade Literature departments. Serving their purpose well, these features however are now grouped in a new section and are presented in a distinct serviceable form intended to expand the scope of their usefulness.*

Clark Maxwell, the great physicist of the last century, with a mechanical toy in his hands as a child, wanted to know the "particular go of it." So does the aviation industry want to know about new and mechanical things. It is to meet this need that AERO *Equipment Digest, beginning with the next issue, will supplement information provided by the manufacturer, when necessary, by simple presentation of the principles involved.*

Also, editorial comment will elaborate on the ability of the equipment to meet the purpose it is intended to serve. And, at times, frank opinion will be given as to the merits of products described. Furthermore, the keyed descriptions and convenient-to-use coupon will save the busy worker valuable time when he desires to secure additional data and information.

This is the policy of AERO *Equipment Digest, initiated at a time when important advances are rapidly taking place in the industry.*

AERO DIGEST Equipment Editor
515 Madison Ave., New York, N. Y.

I am interested in receiving literature on the following items described in the November 1941 issue.

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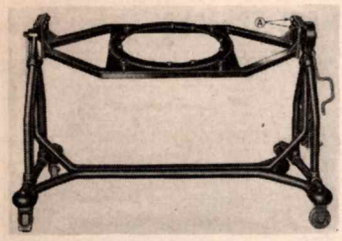
Qualified aviation personnel wishing to obtain additional information on items presented in AERO Equipment Digest may do so by using the convenient form at left. Using their key numbers in the spaces provided for that purpose, specify the items desired. Give your home address, company connection and position. Another opportunity of obtaining additional information on aeronautical products and services is provided by the Advertising Index on page 4.

UNIVERSAL ENGINE STAND FOR MAINTENANCE WORK

AeroED 1 (Nov. 1941) . . . Repair and maintenance stand which will accommodate a wide range of engine sizes. Made of tubing and high carbon steel castings, the Clayborne Aircraft Stand is designed so that its base tubes curve inward from each side. This allows generous accessibility to the engine, and also ample foot room at all times.

The engine mounting frame on all engine stands is primarily the same, but the wide range of sizes and shapes of aircraft engines has hindered the development of a universal stand. The Clayborne stand, however, features a comparatively simple, efficient manner in which the center of balance on the mounting frame can be so placed in relation to the revolving trunnions that it meets the requirements not only of large and small, single and twin row radial engines, but also of straight-in-line engines.

The engine mounting frame is of gusseted heavy T-iron and is



suspended by three bolts at either end ("A" in illustration). By removing two bolts from each end, leaving one in the center, then rotating a half turn on the two center bolts, the frame will be transferred to a point 12.5" away from the center trunnions on the stand. This is a valuable feature in that on most engine stands all of the engine, except possibly the nose or blower section which comprises a small portion of the weight, is mounted on one side of center.

The 50:1 gear ratio on the worm gear operating the engine mounting frame is undoubtedly in excess of normal requirements but is considered as an asset since it is non-reversible and can only be rotated by turning the worm shaft, thus eliminating the need for a locking device to hold the engine in any position in the frame.

On each end of the worm shaft is a ½" square socket which accommodates an ordinary speed wrench or crank. This square socket can be reached from either side of the frame.

The steel mounting ring can be rotated in either direction as required. The engine mounting ring is held in place by heavy grooved steel rollers and is held in any selected position by a spring actuated locking plunger.

Small engines can be mounted in the frame by using slotted steel extensions adjustable for different positions of the mounting bolts. Such engines can either be attached to the mounting ring or the ring may be removed and the slotted members directly attached to the frame.

The stand is mounted on swivel type casters having one row of ball bearings above and one row below the swivel member. This swivel caster is provided with a locking device so that the wheel may be locked by shifting the wheel under the center of the forward mounting. This eliminates the caster action and keeps the wheel from rotating. If desired, the stand may be supplied with four swivel casters.

On special order stands, the company will make up a wide variation of distances between the trunnions at the ends and also regulate the height of the trunnion bearings to suit special requirements. Standard distance between the triangular trunnion plates with the three bolt holes is 57½", and the standard height is 37½" from floor to the bearings.

Motor Rebuilding Specialties, Chicago, Ill.

ERCO AUTOMATIC PUNCHER-RIVETER

AeroED 2 (Nov. 1941) . . . A larger, more versatile model automatic punching-riveting high-speed machine for aircraft fabrication.

These machines are of the "C" frame type and have a 48" throat. They automatically set in a continuous operations cycle all styles of solid rivets, thus eliminating the necessity of pre-drilling, reaming or countersinking holes. They handle rivets up to 5/32" diam, and a booster attachment permits setting rivets up to 3/16" diam. Maximum rivet handled is ½" long.

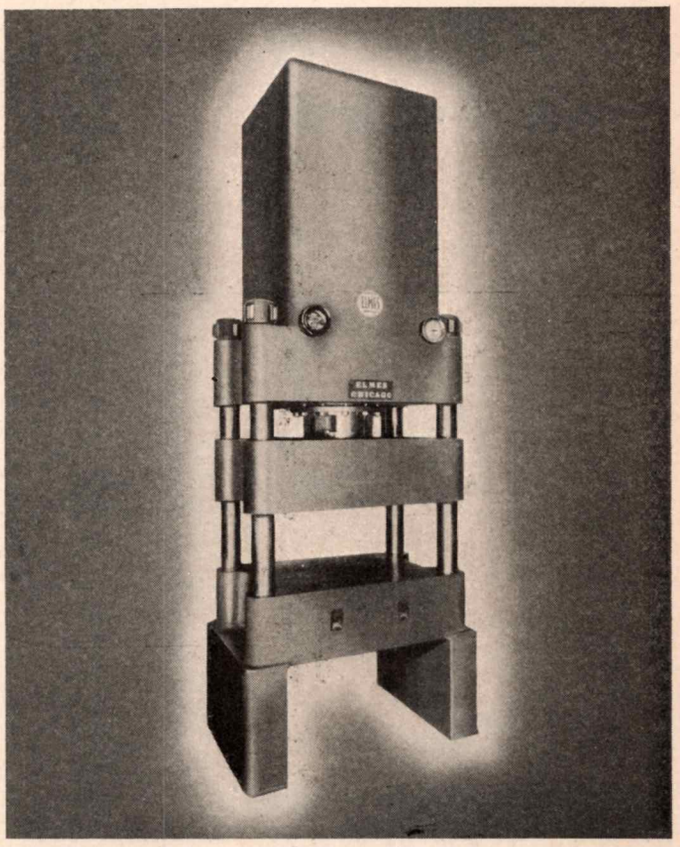
In operation a template with the correct rivet positions is placed over the sheet, and then sprayed to show the rivet positions. The spotted sheet is then clamped to the sections to be riveted together and fed to the punching-riveting head of the machine. A special spotlight indicates where the hole is to be punched.

Air operated remote control on a pedestal permits the handling of large sections, while a drop anvil facilitates work on deep channel sections.

Depressing the left pedal a plain or countersunk hole is punched while simultaneously a

(Continued on following page)

★ ★ ELMES ★
HAS THE
ANSWER
to many defense production problems



YOUR problem may be to produce drawn and formed parts FASTER . . . and at the same time more economically and efficiently. If so, find out about this Elmes column-type press with hydraulic cushion and individual pump.

This press has "planned speed". In fact all features were designed to meet the demand for faster and ever faster production. The cushion cylinder can be accurately adjusted for any cushion pressure up to the maximum by a simple regulating valve. This unit—as well as other Elmes presses—is modern, up-to-the-minute and particularly suited to meet today's defense demands.

Elmes manufactures a wide range of Hydraulic presses, pumps, accumulators, valves and accessories. Inquiries invited.

CHARLES F. ELMES ENGINEERING WORKS, 245 N. Morgan St., Chicago
Also Manufactured in Canada, WILLIAMS & WILSON, LTD., *Distributors*

★ ★ ★ ELMES

(Continued from preceding page) rivet is automatically fed into rivet shoe. The punch remains in the hole keeping the metal in accurate alignment.

Depressing the right pedal the rivet is carried downward by the split rivet shoe. When the point of the rivet touches the punch, the punch is pushed out of the work allowing the rivet to enter the punched hole. As the punch recedes downward, the end surface of the punch becomes part of the heading anvil and completes the operation.

Operation is by pneumatic pressure, using 90-100 psi of air. The punching capacity is for material having a combined thickness equal to the diameter of the rivet, while the countersinking capacity is for a combined thickness equal to 75% of the rivet's diameter.

Engineering & Research Corp., Riverdale, Md.

6¼ INCH PNEUMATIC GRINDER

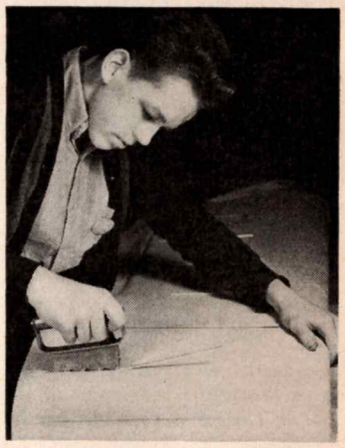
AeroED 16 (Nov. 1941) . . . Measuring 6¼" in overall length, and having a speed of 17,000 rpm for wheels up to 2", the new Model 22BGS grinder has been produced to meet demands for a pneumatic unit that is compact and sufficiently light in weight for one-hand operation, yet rugged and powerful.

The new grinder is equipped with large precision type ball bearings, and is available with either lever or buton throttle and with spindle extension and collets of various sizes.

Aro Equipment Co., 101 Madison St., Bryan, O.

FABRIC ATTACHMENT SPEEDED

AeroED 17 (Nov. 1941) . . . A new method of attaching fabric to control surfaces, which appreciably decreases production time of the process. It will be offered for use by other manufacturers under license.



Although its use on the *Airacobra* is confined to control surfaces, the method is applicable to other types of manufacture where it is necessary to attach fabric to a structure.

Briefly, the method of fabric attachment employs the use of a special tool which forces thin retainer strips into extrusions in the rib construction, thus holding the fabric covering tightly in place. Only a small amount of pressure is required, and the fabric is held tightly, but without danger of tearing.

Direct benefits to be gained from this method include important savings in production costs, increased speed of production, and a resulting attachment which is stronger than the conventional attachment. Tests conducted by Bell Aircraft, under Air Corps supervision, showed the increased strength of the attachment, as well as the fact that as additional pressure is applied, the retainer grips more tightly, without marring the fabric. No holes are made, and patches are not required over the retainer. Time studies show a saving of approximately 75% over conventional stitching procedure, and of 50% over the sheet metal-screw attachment systems now available. Unskilled labor may be employed for the work.

Bell Aircraft Corp., 2050 Elmwood Ave., Buffalo, N. Y.

PORTABLE MAGNETIC VALVE

AeroED 18 (Nov. 1941) . . . A new series of portable magnetic valves usable in a wide number of aircraft applications. Designated the Type PV series, these valves are especially designed to overcome the problems incidental to moving, vibrating, direct current equipment where low current, light weight valves are a necessity.

Three single seated models are available—two normally closed, the other normally open. In addition, there is a double seated normally

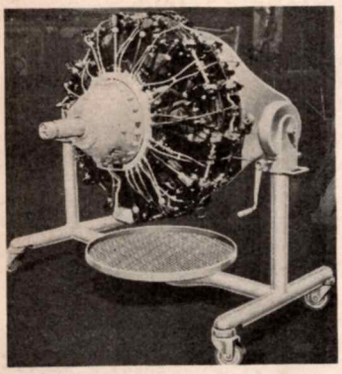
closed type, and a magnetically piloted diaphragm type.

In aircraft use, these valves may be applied to anti-icing controls, on the carburetor air intake or windshield, movable control surfaces or propeller, engine priming, or fuel-line shut-off in the cabin heating equipment.

Features of the valves are direct current operation, freedom from vibration or acceleration, workable in any position, drip-proof up to fully water-proof depending on individual requirements, large volume operation at low pressure or small volume operation at pressures up to 1500 psi or higher, usable on highly viscous fluids, and elimination of magnetic residue due to the use of a magnetic break in both magnetic poles.

General Controls, 801 Allen St., Burbank, Calif.

PORTABLE ENGINE ASSEMBLY STAND



AeroED 19 (Nov. 1941) . . . Simplicity and ease of handling are the features of this new portable engine assembly stand.

Originally designed by Karl O. Larson, chief engineer, Northwest Airlines, it has been thoroughly service tested, and is available for all makes of radial engines. It is only one of a number of special "matched" items now being built for the aviation industry by this new department of the Whiting Corporation.

Whiting Corp., Aviation Dept., Harvey, Ill.

MULTIPLE SPINDLE DRILLING MACHINE

AeroED 20 (Nov. 1941) . . . Accelerated production on small-hole drilling and tapping operations is now obtainable with this new series of two, three, and four-spindle drilling machines. The drilling heads incorporate the well-known ball bearing-equipped floating drive featured in all Atlas heavy duty drill presses.

Table weight of the three and four-spindle machines is estimated at 575 lb, furnishing a solid support for the smooth movement of heavy jigs, fixtures and parts in production quantities. Each drilling head is SKF ball bearing-equipped, has its own motor mounting and a new type of positioning control with crank handle.

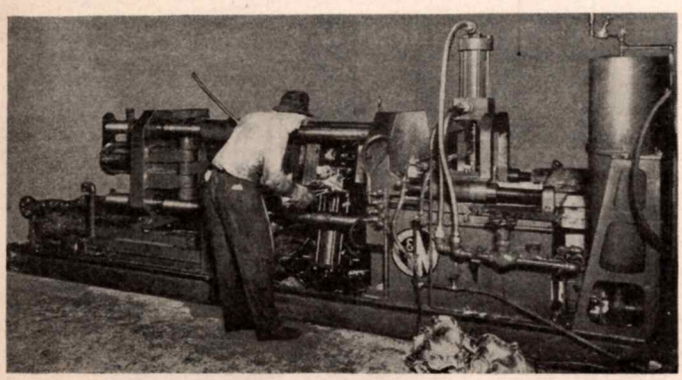
Condensed specifications show: center distances between spindles 15″, 18″ and 13″ respectively; table to Jacobs chucks 26″, to No. 1 Morse tapers 24¼″; column to center of spindle 7½″; table surface (3 and 4 spindle types) 21″ × 54″; spindle travel 4″.

Atlas Press Co., Dept. 7, Kalamazoo, Mich.

ALL-WELDED DIECASTING MACHINE SPEEDS OUTPUT

AeroED 56 (Nov. 1941) . . . All-welded diecasting machines sufficently strong and rigid to make sound castings with little "flash" on high speed production schedules are now in successful production. These machines, designed

(Continued on following page)



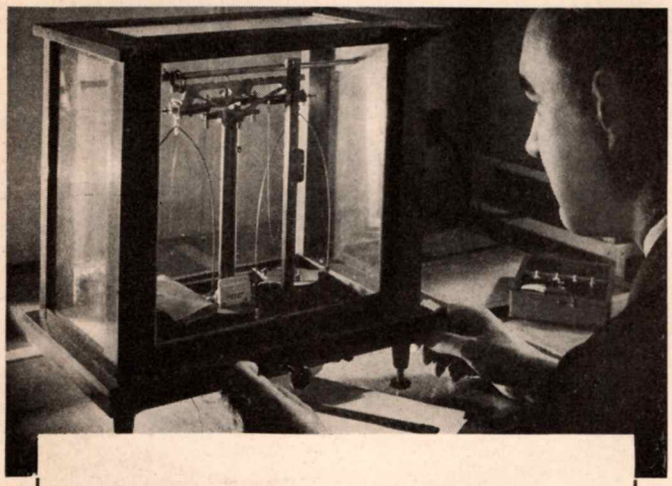
G & N machine which speeds production of die-casting

THE GRUMMAN WIDGEON. PHOTOS BY COURTESY OF GRUMMAN AIRCRAFT ENGINEERING CORPORATION

WITH GRUMMAN, TOO,
IT'S Naugahyde
UPHOLSTERY!
NAUGAHYDE-upholstered seat in the Grumman Widgeon
WHY IS GENUINE U. S. Naugahyde
SO WIDELY PREFERRED FOR AIRCRAFT SEATS?
Leading aircraft makers will tell you it's simply because Naugahyde upholstery delivers more, in looks and wear, per dollar of cost. Naugahyde combines tough leather fibres with flexible rubber. Lightweight. Non-absorbent—wipes clean easily. Wears smooth and crack-free. Doesn't "bag" (or stretch permanently out of shape).
UNITED STATES RUBBER COMPANY
Coated Fabrics Division • Mishawaka, Indiana

Light Weight

PLUS STRENGTH



. . . makes a fine aircraft fabric

HAVE you looked at aircraft fabric specifications lately?

There have been some changes made. One of the most remarkable has been the increase in the weight-strength ratio. Fabrics today are stronger, lighter in weight than ever before.

Airwing Aircraft Fabrics are keeping pace with America's fast moving aviation industry. We maintain rigid manufacturing controls throughout every step in the making of these fine cloths. Then the Thurston Laboratory tests . . . tests . . . tests—just to be on the safe side.

Are you using Army and Navy Specification fabrics? Do you manufacture light planes? Are you sub-contracting fabric-covered surfaces? You will wish to know all about Airwing products.

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☆THURSTON CUTTING CORPORATION☆

Main Office: 40 Worth Street, New York, N. Y., U. S. A.

Laboratory, Cutting Factory and Warehouse at 17 Beach St., New York, N.Y., U.S.A.

(Continued from preceding page)

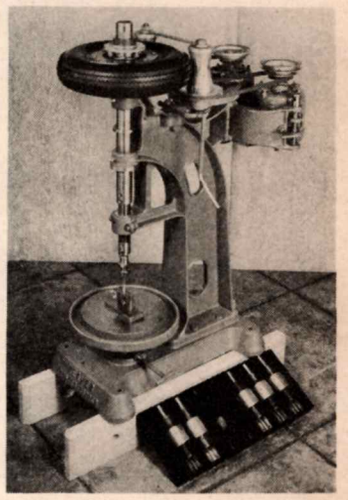
for casting of zinc, tin, lead, aluminum, brass and magnesium alloys, employ massive steel welded construction in the base, cylinder mounting, cylinder head, furnace, hydraulic fluid tank, shot cylinder, and goose-neck support. Only a few bolts and stud fastenings are used throughout the machine. Die plates of 6" thickness and 4" tie bars extend through them.

The machine is a G. & N. die-casting machine employed with three hydraulic core pullers which work cores in three different directions. These automatic core pullers permit extremely fast operation. When making small simple castings without cores or complex parts and using automatic ejection, the machine may be operated at a speed of 600 cycles per hour. Due to the strong construction of the machine, it has been found to operate satisfactorily at rates 20 to 30 percent faster than those usually practiced.

G. & N. Mfg. Co., Cleveland, O.

WEAVER PRECISION TAPPING MACHINE

AeroED 4 (Nov. 1941) . . . A precision tapping machine embodying new principles of design for precision tapping and threading.



Simplicity of the drive mechanism and long life of the master lead screw and split nuts in conjunction with a rugged cast frame and ample ball and bronze bearings, permits this machine to turn out Class 3 fits with inexperienced help.

An adjustable driving clutch mounted in the pneumatic tire wheel is of ample size and sensitivity to give extensive service. Adjustment of the clutch for any torque provides protection against negligent tap abuses.

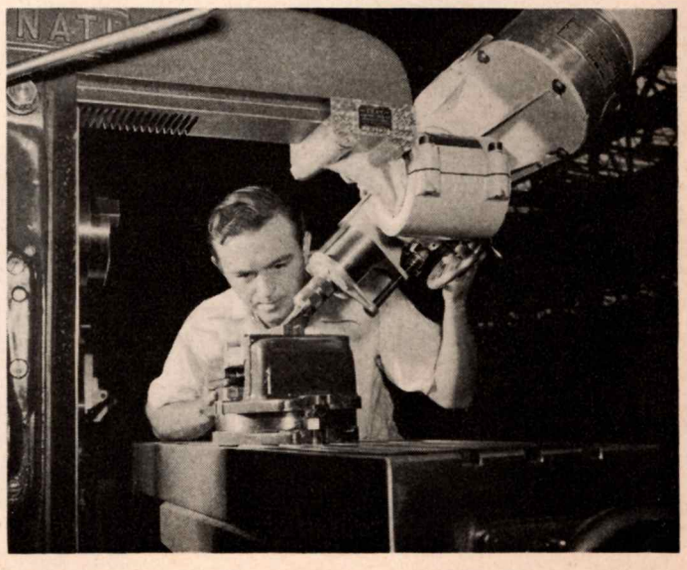
The machine is equipped with two ½ hp motors and one set of lead screws and split nuts. These master screws will thread 16-18-20-24-28-32 threads per inch. Master lead screws of any thread can be supplied. The drive spindle is ground to take any ⅝" straight shank chuck on tap holder.

Weaver Aircraft Corp., 1341 State St., San Diego, Calif.

ALL-ANGLE MILLING MACHINE

AeroED 10 (Nov. 1941) . . . A versatile machine tool which can be used for milling, drilling, boring and grinding operations in vertical, horizontal and angular positions without changes in setup.

Equally suited for toolmaking or production work, the *All-Angle* milling machine head can be swung to any angle or compound



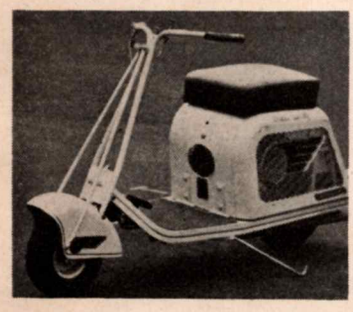
angle, and the turret cross slide can be set at any angle for angular machining operations. Universal feature of the machine is achieved by a combination of a 10" cross travel above the table and a 11.5 diam turret head with 360° calibration, held rigidly at any point by four ¾" dovetail bolts.

The *All-Angle* milling attachment is available for use on other milling machines.

Fray Machine Tool Co., Glendale, Calif.

LOW COST GROUND TRANSPORTATION

AeroED 21 (Nov. 1941) . . . Restricted parking space and heavy traffic at factories around the shift-change hours make use of a small means of conveyance a great convenience to aircraft factory workers and others. In addition, such a vehicle can be put to a great number of uses on the airports, and for quick delivery of necessities between one plant and another.



The *Motor Glide* is a single seat powered two-wheel vehicle which operates 100 miles to a gallon of gas, requires minimum maintenance, and is small enough to get into and out of heavy traffic and small parking areas. There is a 23 hp single cylinder engine which provides power for hill climbing and fast acceleration, automatic starting and driving clutches, generator and lighting system, and many of the accessories which usually are installed in automobiles. No shifting of gears is required since a combination of throttle and clutch produces a dynamic drive which automatically changes drive ratios according to road speeds.

Salsbury Corp., 1161 E. Florence Ave., Los Angeles, Calif.

MORE PROTECTION FOR FUEL TANKS

AeroED 8 (Nov. 1941) . . . Additional protection for self-sealing fuel tanks is now possible as a result of the development of a new rubber derivative called *Plioform*. This new plastic can be used to replace the aluminum shell of the fuel tank and to give added assurance against fuel leaks caused by punctured or burst tanks.

While fuel tanks were provided with positive self-sealing rubber linings, nevertheless the outer aluminum shells had a tendency to flare when penetrated by heavy calibre bullets, particularly if the bullets tumbled while passing through the tank. These projecting splinters often held open the

(Continued on following page)

Results of penetration by 50-cal. bullets in Plioform treated and aluminum cased fuel tanks

WELDWOOD

. . . *the GLUE of the Aviation Industry*

WELDWOOD PLASTIC RESIN GLUE has been approved for aircraft by the United States Navy, United States Army and the Civil Aeronautics Administration when properly applied* . . . endorsed and used by America's leading manufacturers of aircraft and aircraft parts.

WELDWOOD GLUE is a cold setting, one-part plastic that requires no heat or hardener. It mixes instantly with tap water—ready for immediate use. Upon setting up, WELDWOOD GLUE becomes Waterproof, Stain-free, Rot-proof and Enduring.

*Sample can of WELDWOOD GLUE, test report and process specifications are available on requests made on firm letterheads.

The USP Research Laboratories are at customers' disposal in reference to special glueing problems.

UNITED STATES PLYWOOD CORP.

World's largest producers of Plywood

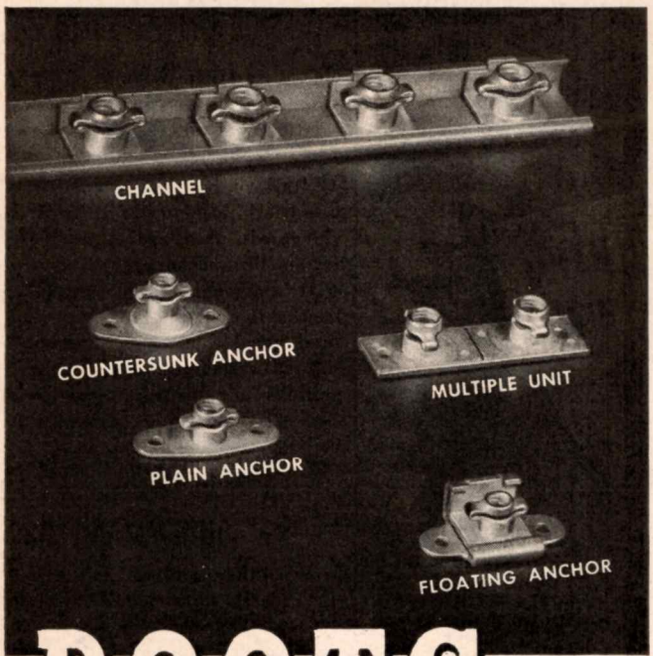
616 West 46th Street, New York, N. Y.

WELDWOOD
PLASTIC RESIN
WATERPROOF GLUE

SHEDDING 10 20 30 40

AND UP TO 60 POUNDS OF

DEAD WEIGHT BY USE OF



BOOTS

SELF-LOCKING AIRCRAFT NUTS

"Outlast the Plane"

This revolutionary light-weight, all metal, one piece, self-locking, aircraft nut is stronger at half the weight. Today, leading aircraft manufacturers report:

UP TO 60% WEIGHT SAVINGS

in the use of BOOTS AIRCRAFT NUTS wherever self-locking nuts are applicable.

• • •

Authorized for use by ARMY, NAVY, C.A.A., BOOTS AIRCRAFT NUTS meet all specifications and are being used throughout the airplane by a majority of leading aircraft manufacturers.

• • •

WRITE *NOW* FOR VALUABLE TECHNICAL DATA arranged in an easy-to-file folder. "Boots Standard Sheets" give you all the information you want.

Manufactured by
Scovill Mfg. Co., Waterbury, Conn.
United Carr Fastener Corp., Cambridge, Mass.
for
BOOTS AIRCRAFT NUT CORP.
NEW CANAAN, CONN.

(Continued from preceding page) punctures of the inner rubber lining, causing fuel leakage.

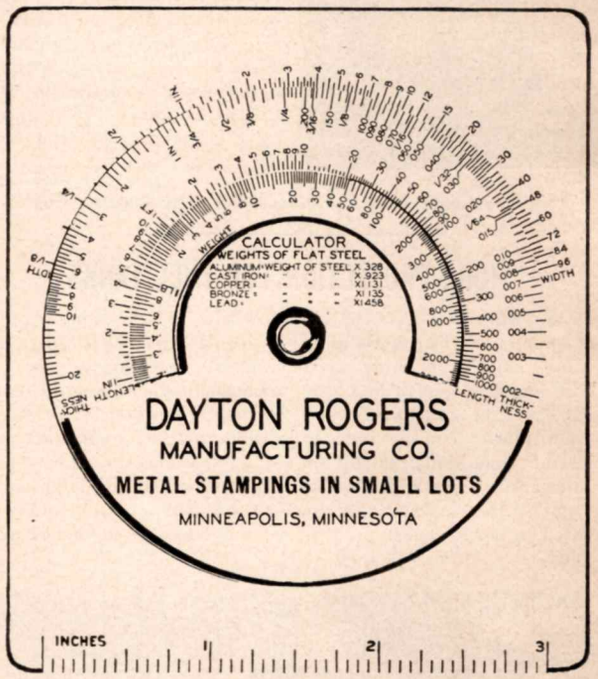
However, use of *Plioform* as the outer shell has eliminated this difficulty, and has also solved the problem of tanks bursting in crashes. It does not flare under gun fire and will not burst open under crash impact. Little has been said concerning the method of processing *Plioform*, but it is known that crude rubber is used in combination with a rubber resin.

Goodyear Tire & Rubber Co., Akron, Ohio.

WEIGHT CALCULATOR FOR SHEET AND STRIP METALS

AeroED 14 (Nov. 1941) . . . A new, revised and improved metal calculator which automatically gives the correct weight of any sheet or strip stock relative to the piece part weight in connection with all sheet metal requirements in the factory.

While this slide rule is primarily laid out for strip and sheet steel there is an automatic conversion table for such materials as aluminum, copper, bronze, and other sheet alloys. The piece part weight is instantly recorded after knowing the weight of the stock, including the thickness, together with the length required. Extremely handy for calculating weights on all materials used in the average punch press department, the rule will calculate sheets in width from 1/3" to 96" wide, in thicknesses from .002" to 1" thick, and in length from 1/4" to 1000 ft.



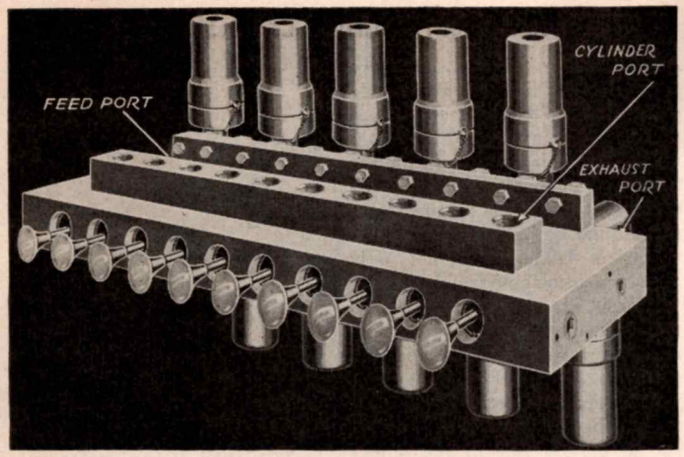
Dayton-Rogers Mfg. Co., 2830 13 Ave., Minneapolis, Minn.

MACHINE-GUN CHARGING VALVE

AeroED 7 (Nov. 1941) . . . Faster and more efficient machine gun charging is now possible through the use of a hydraulic gun-charging valve that provides in a single unit the means of charging ten guns individually or simultaneously. It has an electrically energized automatic mechanism for returning the valve to neutral position and since it can take the place of ten separate hydraulic gun-charging valves, it reduces by 60% the amount of tubing, connections, and fittings ordinarily required.

Designated Type B-10-C, the valve consists of ten units but can be furnished for any desired number of guns. It weighs less than 16 lb and requires only a 1/2" pull of the proper valve stem to operate the desired gun-charging cylinder. This valve stem remains latched in operating position until the gun is charged, at which time an automatic electric switch energizes a solenoid, releasing a latch which allows the valve stem to return to neutral. When the piston is returned to neutral, the gun-charging cylinder is automatically connected with the return line to the reservoir.

The valve stems can be pulled at will, separately or simultaneously, and will be returned electrically as their functions are completed In case of electrical failure, each



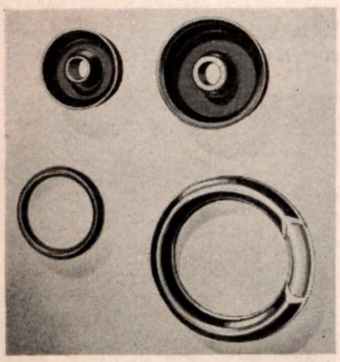
unit can be operated manually, without interference from the latching mechanism in that it can be returned to neutral merely by pushing the stem back to its stop.

The valve will operate without seizure from lower than —40°F to +200°F. Being fully balanced, it requires a minimum force (3-4 lb) to operate over and above the force used in overcoming the centering spring. Normal operating pressure can be carried up to 1500 psi and test pressures are carried to 4000 psi pounds per square inch.

In addition to the B-10-C unit, Fleetwings has developed another gun-charging valve that is similar except that it is not equipped with a latching mechanism and solenoid release. In order to charge a gun with this valve, which is known as Type B-10-B, the valve piston is pulled out manually, by ½" movement, and held until the gun is charged. By releasing the piston a spring is permitted to return the valve to neutral and thus the gun-charging cylinder is automatically connected with the return to the reservoir. The standard B-10-B valve consists of ten units, weighs 10 lb, and can be furnished for any desired number of guns.

Fleetwings, Inc., Bristol, Pa.

AMERIPOL COMPOUND MAKES EFFECTIVE HYDRAULIC SEAL



AeroED 5 (Nov. 1941) . . . A new formula by which *Ameripol* (Goodrich trade mark) synthetic rubber has been successfully compounded into a molding material for oil seals, V-type packings, accumulator diaphragms, and one which is ideal for sealing all parts of aircraft hydraulic systems.

It is particularly noted for its —50°F resistance to sub-zero temperatures, exceptionally low oil absorption, low friction, flexibility, fabrication to close tolerances and high resistance to metal corrosion, heat, light and ozone.

Miller Rubber Co., Inc., Akron, Ohio.

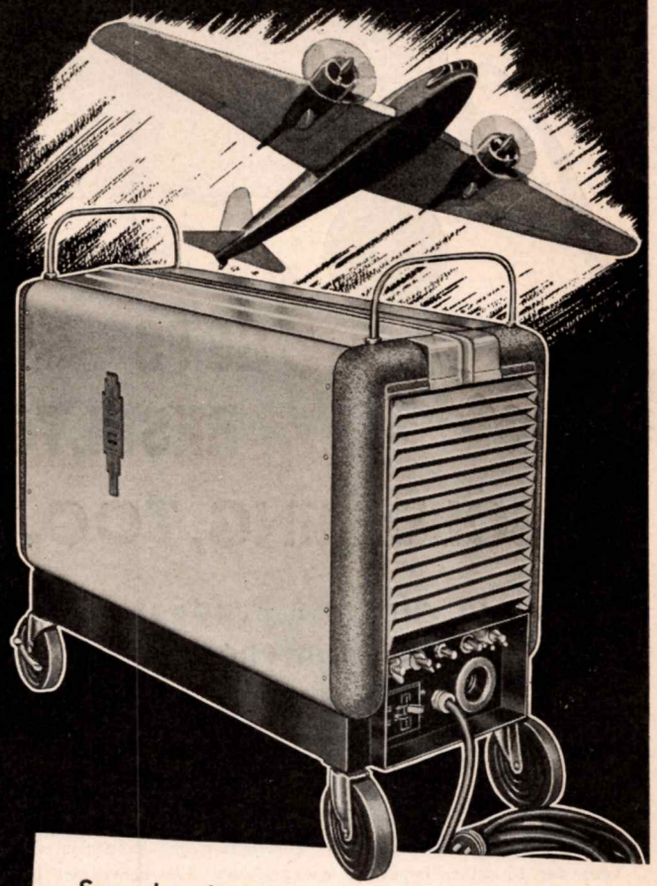
NEW WEATHER INSTRUMENT TO AID LIGHTING SYSTEMS

AeroED 6 (Nov. 1941) . . . Sponsored by the CAA. A new instrument called the transmissometer automatically determines the extent to which light is transmitted through the atmosphere under varying conditions. The instrument will be used when perfected as an aid in improving the lighting systems of airports and airways by permitting a determination of the visual range under different atmospheric conditions. It measures the transmission of light between two points and relays a code signal to some remote point by wire or radio, where it is recorded for reference.

An instrument which would record automatically the transmissivity of the atmosphere for light would be of great value in the design and operation of airway and airport beacons, approach, runway and boundary lights. It would make it possible for weather observers to give measured values of visibility instead of depending upon estimates of visual range.

U. S. Bureau of Standards, Dept. of Commerce, Washington, D. C.

ANOTHER MODERN DEVELOPMENT
for the Aircraft Industry:
BL Portable Power RECTIFIER
designed by B-L Engineers in cooperation with aircraft engineers and production experts



Speed and efficiency are priceless factors. The aircraft industry demands a heavy duty, highly flexible, and ever-dependable source of DC power for testing and starting various types of aircraft and DC Motors. To meet this need, the B-L Portable Power Rectifier has been designed.

These sturdy, compact units are in daily use today in aircraft plants. They are doing their part to keep production, testing and starting moving on schedule.

Write today for full details and prices.

BL ELECTRICAL RECTIFIERS
the BENWOOD LINZE CO.
Engineers • Manufacturers
1810 LOCUST ST. • ST. LOUIS, MO.

Control GETS RESULTS IN SOLDERING, TOO..

. . in Aircraft Production and Maintenance

Control of both flux and alloy—as to both quality and quantity—the positive control that you get with Kester Cored Solders—is essential to meet the highly exacting requirements of the aviation industry.

The alloy in Kester Cored Solders is all pure, virgin metal! It resists bending, shock, vibration, contraction and expansion. Failures due to solder impurities are unknown. The convenient form of Kester Cored Solders makes work move faster, too!

Permanently trouble-free and corrosion-proof electrical circuits are insured by the use of Kester Rosin-Core Solder. The patented plastic rosin flux will not corrode terminals or injure insulating material. It is self-contained in the solder, in exactly the right amount for perfect results.

Consult Kester engineers, backed by 42 years of specialized experience, about any question involving solder. Write them fully; there is no obligation.

KESTER SOLDER COMPANY

4221 WRIGHTWOOD AVENUE, CHICAGO, ILL.

Eastern Plant: Newark, N. J. Canadian Plant: Brantford, Ont.

KESTER CORED SOLDERS

STANDARD FOR INDUSTRY

PAN AMERICAN AIRWAYS EXTENSION LADDER

AeroED 3 (Nov. 1941) . . . A piece of equipment that is saving considerable time in the maintenance of large aircraft. Used both for quick engine inspection or for the inspection of those parts of the airplane that cannot be reached from the ground or hull, the unit is an extension ladder that not only gives an adjustable height to the platform at the top, but also makes it possible to move the ladder under wings, struts and tail sections.

Extension and retraction is controlled by a crank and ratchet system on the side of the ladder about 3 ft from the ground. The ladder rolls on four 4" swiveling casters which are retracted when the ladder is placed in position to keep it rigid.

Designed and manufactured by Pan American Airways Maintenance Department, the ladder is being used at two bases in Miami as well as at other PAA stations.

Pan American Airways, Maintenance Dept., Dinner Key, Fla.

IMPROVED METHOD FOR RESISTANCE WELDERS

AeroED 22 (Nov. 1941) . . . A line of refrigerating units for welding machines designed to increase productivity of resistance welding equipment in welding of aluminum and stainless steel.

While intended to still further increase the productivity of Progressive aluminum and stainless steel welding machines, the refrigerating units are available for other makes of welding machines.

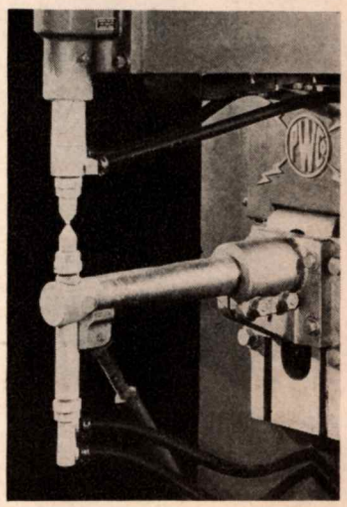
Believed to be the first time refrigerated welding has been made commercially available, the unit makes possible continuous welding of four to ten times as many spots in aluminum without requiring point dressing.

When used in combination with a spot welding machine, the unit reduces electrode temperature to a point where—in spite of the high heat necessary to produce a weld—electrodes will be continuously covered with frost. This reduction in temperature has so increased point life that 10-minute runs, continuously, at 100 welds per minute without point dressing are not unusual for the combination of a Progressive three-phase aluminum welder and the new refrigerating unit.

Primary function of the refrigeration is to keep the welding point cool at the point of contact. In resistance welding heat is generated at three primary resistance points of contact between the pieces being welded together, between the "upper" piece and upper electrode, and between the "lower" piece and the lower electrode.

Only the first is desirable, the other two tending to soften and permit deformation of the electrode tip—also producing pick-up, by alloying of the tip with the material being welded.

Experimental production to date indicates elimination of pick-up when the refrigerating unit is used, particularly on the progressive aluminum and stainless steel



welders, for which a new harder and tougher tip material than generally available was developed some time ago. Retention of tip shape by preventing softening is also reflected in the maintenance of higher current density at the weld.

The unit can also be used for welding other types of material besides aluminum and stainless,

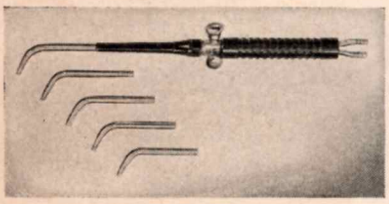
and may also be applied to the cooling of industrial coolants, cutting oils, etc.

Peculiarly enough, while the refrigerating unit absorbs a considerable amount of heat, experience indicates that welding machine settings are actually lower than when operating with water cooling. The lower setting of the heat control generally required is probably due in part to the higher conductivity of copper at the lower temperature.

Installation of the refrigerating unit is simple. Being self-contained, it is necessary in most cases only to disconnect the water-lines to the electrodes and couple the refrigerator unit inlet and outlet connections to the electrode water piping.

Progressive Welder Co., 3050 E. Outer Dr., Detroit, Mich.

BALANCED 5-OZ. WELDING TORCH



AeroED 12 (Nov. 1941) . . . Series 9-E aircraft welding torch, weighs 5 oz. It has been designed for aircraft welding where lightness and balance are required. Special features include cool grip fibre handle, spring tension valve adjustment and duralumin tip tube. Five tips, numbers 2 to 6 inclusive, are available with the torch.

Dockson Corp., 3839 Wabash Ave., Detroit, Mich.

SLIDE RULE EXTENDS RANGE OF COMPUTATIONS

AeroED 23 (Nov. 1941) . . . A slide rule designed as an aid in making and checking calculations for mechanical drawings, laying out machine shop jobs, making patterns, *etc.* Unlike the usual slide rule which multiplies and divides, the Sum-Up slide rule adds, subtracts and *converts* decimals of an inch, fractions of an inch and millimeters interchangeably and the answer can be read in fractions, decimals and millimeters.

Sum-Up Slide Rule Co., 114 Liberty St., New York, N. Y.

POWER SHEARS GIVE GREATER SPEED, ACCURACY

AeroED 33 (Nov. 1941) . . . Accuracy heretofore unattainable is claimed for the new Series No. 4 line of power shears. Sheared edges can reliably be cut that are straight to within a few thousandths of an inch of a straight line, without the need for employing an operator with special skill. Narrow strips, accurate to gauge setting and parallel within close limits, are easily produced without camber or curl.

Higher production is made possible because of the higher operating speed, the instant engagement of the Niagara sleeve clutch, the quick release of the holddown, and the convenient arrangement of features for the operators. Strips may be cut at the rate of 75/min on 60 cycle current.

The drive including the flywheel, gearing, clutch, eccentrics, and connections are enclosed within the machine and operate in a bath of oil. A new device replaces the customary friction brake and requires no adjustment.

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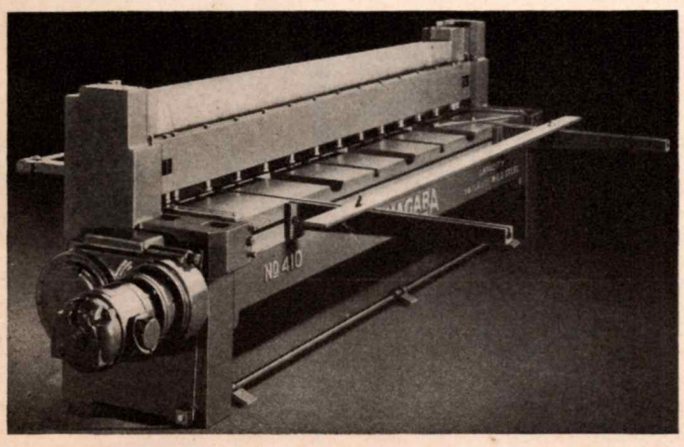


For the life of the bearing

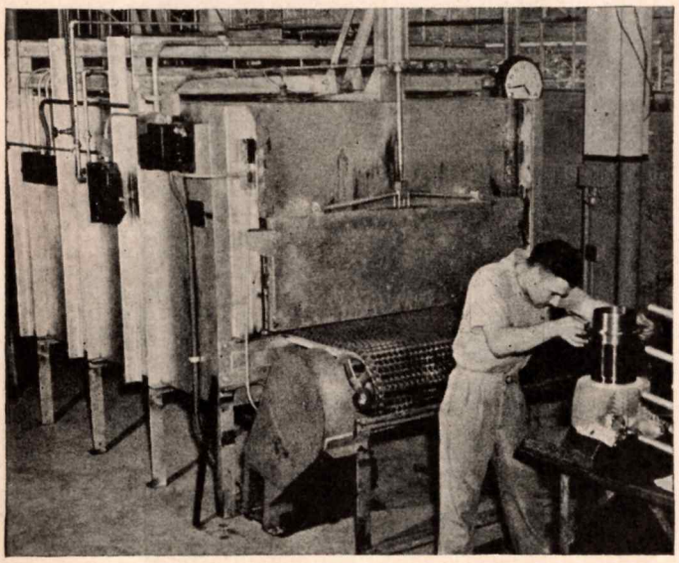
To take up bearings . . . to align or space parts . . . simply peel .002 or .003-inch laminations from the brass Laminum shim. Right at the job . . . no filing, grinding, miking. Speed, accuracy and cost-saving in factory and field service adjustments! • *Shims cut to your specifications . . . stock shim materials carried by your mill supply distributor.*

Laminated Shim Co., Inc.
68 Union St., Glenbrook, Conn.

Write for file-folder of shim application photos — with Laminum sample.

LAMINUM
TRADE MARK
THE SOLID SHIM THAT peels FOR ADJUSTMENT
A-1166

Heating Aluminum Engine Heads *TO SPEED DEFENSE!*



AT WRIGHT Aeronautical Corporation, this MAHR electric furnace is used to heat aluminum aeroplane engine heads to 570° F. While the aluminum head is hot, the valve seats, valve guides, bronze rocker shaft bushings and finally the steel cylinder barrels are inserted. All inserted parts are at room temperature. As the head cools, it contracts and the resultant "wedding" of parts is permanently tight.

This is but one way in which MAHR furnaces of different types, sizes and purposes are speeding defense. Our engineers will gladly consult with you on any standard applications or special designs needed. No obligation.

MAHR

is making astonishingly prompt deliveries on heat treating equipment of all kinds, due to our large trained personnel and manufacturing facilities. For over 25 years, the name MAHR has represented the most advanced and efficient designs in furnaces of all kinds.

★

WRITE US TODAY for bulletins and detailed information on any furnace installation. Car bottom, batch, continuous, rotary, annealing, carburizing, stress relief, nitriding, etc. Atmosphere generators.

DIAMAHR

MAHR MANUFACTURING CO.

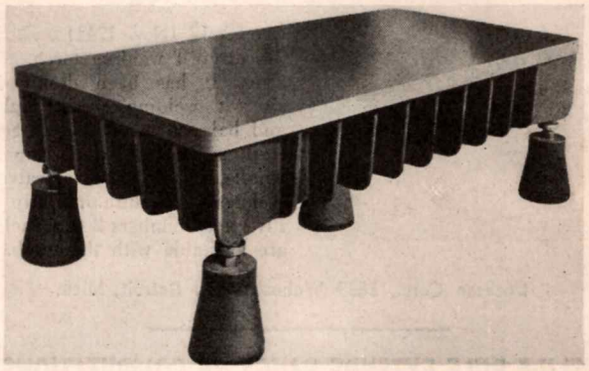
MINNEAPOLIS, MINNESOTA U. S. A.

(Continued from preceding page)

Standard equipment includes a direct connected 3 phase, 60 cycle, 110 or 220-440 volt ac, ball bearing, splash proof motor wired with magnetic starter, and start and stop push button control; one pair of four cutting edge solid tool steel knives; adjustable, stainless steel scale inlaid at each end of bed; front gauge with two front brackets, side and bevel gauges, and a ball bearing, self measuring, parallel operating back gauge adjustable at 1/128″ increments. These new power squaring shears are available in 4′ to 12′ lengths, and in from 12 to 16 gauge.

Niagara Machine & Tool Works, 637 Northland Ave., Buffalo, N. Y.

SOUTH BEND SURFACE PLATE MEASURES 4′ × 8′



AeroED 32 (Nov. 1941) . . . Cast in semi-steel and finished plane within .005″ a new 3-ton surface plate measuring 48″ × 96″ offers seven support-points for utmost flexibility in usefulness. Two sizes of adjustable blocks or legs (10″ and 12″) provide possible working-surface heights between 29″ and 33″. The blocks support threaded 1.5″ screws, each topped with a circular cap which is recessed to contain any of the projecting support-points on the bottom of the plate. A 12-pitch thread provides fine adjustment to compensate for floor irregularities, *etc.* The ribbed underside of the plate is designed to provide maximum strength at low weight.

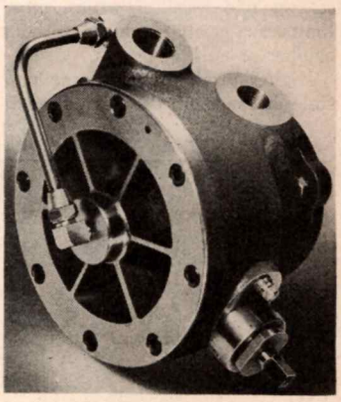
South Bend Tool & Die Co., 1916 S. Main St., South Bend, Ind.

VANE TYPE VARIABLE DELIVERY PUMP

AeroED 34 (Nov. 1941) . . . An infinitely variable delivery hydraulic pump of dual vane design which employs a unique means of balancing the vanes so that overheating is eliminated, wear is reduced and the pump is virtually breakproof.

Designed for continuous operation up to 1250 psi pressures, the new pump is recommended for use where the possibility of line surges require a "breakproof" pump. Delivery is infinitely variable over two ranges—4 to 0 gal/min, and 8 to 0 gal/min. The pump can also be used where periodic pressures go as high as 2000 psi. Increasing or decreasing the rate of delivery is achieved by an adjustment screw and can be done while the pump is operating.

Instead of the conventional single blade vane, the new *Dudco* pump employs dual vanes. Each vane is bevelled around its entire edge so that oil from the oil hole in the rotor can flow around all the edges of the dual vanes. The result is that a "back" pressure, variable to suit individual conditions, can be placed on the vanes from the stator side. Thus, each set of vanes is held against the stator with only a portion of the total operating pressure of the pump. This eliminates possibility of overheated vanes and minimizes



wear. The bevelling also serves to hold the vanes "centrally" with respect to the housing, thereby reducing housing wear.

Another feature of the pump is the method by which the split

stator is so arranged that either or both halves can be moved to increase or decrease the delivery rate. Housing of the pump is for flange mounting with adjustment screws at opposite sides.

Intake and output connections are at the top. Any oil leakage from the inside of the pump into the outer part of the housing is returned to the intake through a return line.

Vanes, rotor and stator halves are of hardened and ground steel as is the splined drive shaft used in the device.

Detroit Duplicator Co., 253 St. Aubin, Detroit, Mich.

PLASTIC INDUSTRIAL EYE PROTECTORS

AeroED 41 (Nov. 1941) . . . Growing out of the need for a device for industrial eye protection which would allow the wearer unrestricted wide angle of vision and at the same time afford complete protection, *I-Gards* are a new development in the plastics field. Light, comfortable, strong, they are produced without individual grinding of lenses.

They are injection-molded of clear plastic under rigid controls which assure optical accuracy and maximum strength. In addition to clear lenses, they are also provided in a green *Vernalite* tint, a color which satisfactorily filters out glare and harmful light rays. The design employed eliminates pressure on the bridge of the nose and on the ears, and adequate ventilation improves the material's non-fogging characteristic.

B. F. McDonald Co., 1248 So. Hope St., Los Angeles, Calif.

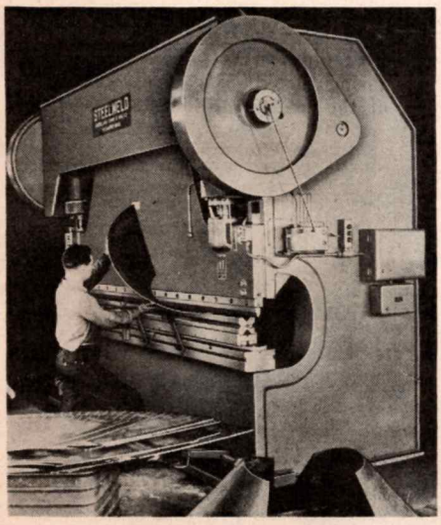
LIGHTWEIGHT, COMPACT DRILL

AeroED 13 (Nov. 1941) . . . Light in weight and compact, and developing approximately twice the power of ordinary, similarly rated, production-duty electric drills, the *Thor* U14FS series ¼" aircraft drill is particularly useful for operation in restricted spaces or in unusually difficult positions. These drills are available in three different speeds and have side switch style handle for either continuous or intermittent drilling.

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill.

PRESS MAKES CONICAL PARTS WITHOUT SPECIAL DIES

AeroED 35 (Nov. 1941) . . . Steelweld bending presses are now being equipped with a ram-tapering mechanism which permits the production of conical sections with the use of only standard bending dies.



Tapering the ram requires only the operation of the ram-tapering lever which disengages the ram clutch. This permits operation of the right-hand ram screw only, which raises or lowers the right end of the ram, thus producing tapering. Either end of the ram can be tapered as much as .25"/ft length of bed.

The press illustrated is shown working steel 3/16" thick. Two of the sections being formed make the bottom of a 48"diam bucket. This machine is a Steelweld bending press Model 14-10 which will handle 10 ft by 5/16" between housings, and 12 ft by .25" over the entire length of bed and ram.

Cleveland Crane & Engineering Co., Steelweld Machinery Div., Wickliffe, Ohio.

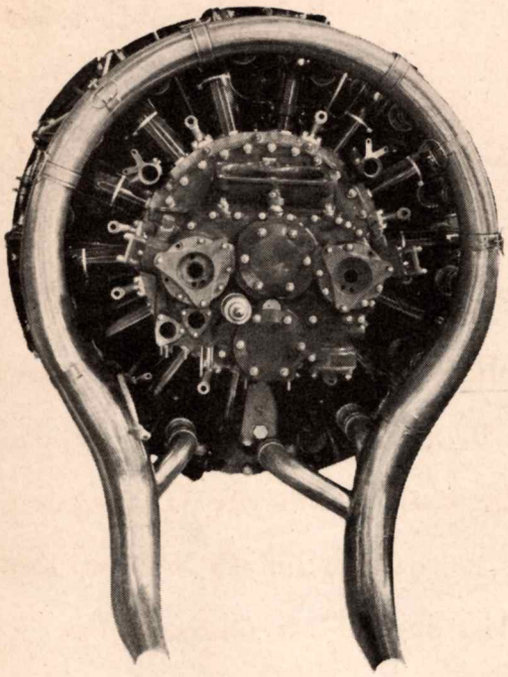
In the months ahead, with the demand for Packard aircraft cable steadily increasing, Packard will continue producing fine electrical cable for all aircraft needs—as usual!

Packard
REG. U.S. PAT. OFF.
TRADE MARK

PACKARD ELECTRIC DIVISION
General Motors Corporation, Warren, Ohio

PRATT & WHITNEY

power



POLLAK

exhaust manifolds

Above Twin Wasp Exhaust Manifold weighs 44 lbs., including 4 supports to engine. All branch tubes have two flexible joints. Pollak Manifolds are designed to eliminate failures due to stresses resulting from change in temperature or fatigue in vibration.

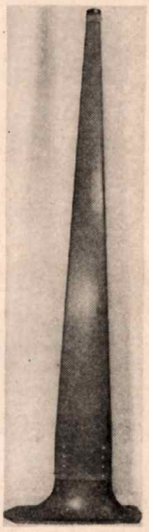
POLLAK MANUFACTURING CO.
ARLINGTON, NEW JERSEY

PLASTIC RADIO ANTENNA MAST FOR AIRCRAFT

AeroED 70 (Nov. 1941) . . . Entered in *Modern Plastics* competition, an aircraft radio antenna mast was built of molded macerated and molded phenolics to achieve structural efficiency coupled with light weight. Ease of fabrication and installation dictated the use of a three-sectioned assembly—the base, cap and mast. The cap functions as a closure for the top of the tube and provides for the attachment of the antenna wires; it is of macerated fabric filled phenol-formaldehyde molding powder for high strength and impact qualities.

The base serves as the bottom closure and attaching mount; it is of plastic similar to the cap, but is augmented by 5 laminations of canvas integrally molded around the flange. The tube is thin-walled, of tapering streamlined section and is made of molded laminated phenolics.

The assembly provides a high dielectric unit which gives protection not attainable from metal construction without making specific provision in the form of additional insulators in the antenna system.



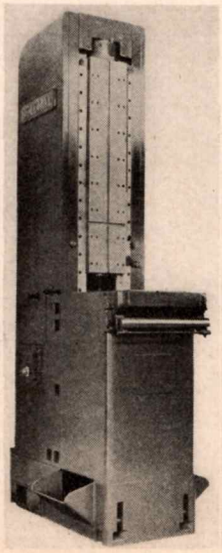
Glenn L. Martin Co., Baltimore, Maryland

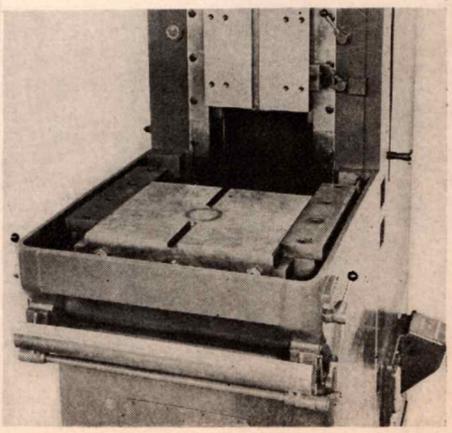
IMPROVED LINE OF BROACHING MACHINES

AeroED 40 (Nov. 1941) . . . Increased size of work table and ram, and new streamlined design feature an improved standard line of single ram broaching machines. Each machine is adapted to a wider range of tooling than formerly; and peak capacities have been increased to give ample reserve power when operating at normal rated capacities. Normal capacities of the various sizes range from 3 tons and 36″ stroke up to 25 tons and 66″ stroke for the 11 standard models.

Column widths have been increased, permitting increased ram width on each of the machines which in turn provides better support for wide bars. In keeping with the increased width of the broach ram, the work platen has also been increased in width. The machines embody a new cylinder design using seamless steel tubing in connection with welded construction for leak-proof operation. Another feature is the vertical mounting of the main drive motor inside the column, reducing the amount of floor space needed for installation.

Improvements simplifying the construction of the receding table mechanism allow for the effective installation of chip wipers, protecting the bearing surfaces of the moving platen. The new design of the table provides finish-





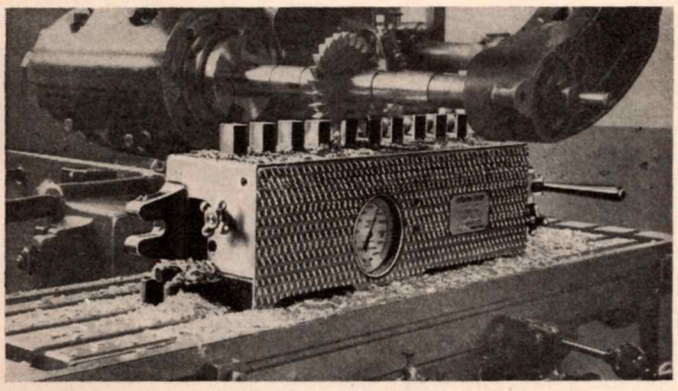
machined pads on the front as well as on both sides for mounting auxiliary units such as cams, *etc.*, used to automatically operate clamps, locks and support jacks on the fixtures. At slight extra cost, provision can be made for clamping work pieces in position in a fixture by utilizing the cylinders of the hydraulic system of the machine. A standard Colonial feature, the cam lock and narrow center guide for the receding table mechanism is provided.

Colonial Broach Co., 147 Joseph Campau, Detroit, Mich.

HOLDER ATTACHMENT SPEEDS GANG MILLING OPERATIONS

AeroED 39 (Nov. 1941) . . . Use of *Hydra-Grip* work holders is said to speed up gang milling operations on small machine parts by reducing loading and unloading time to a minimum and making possible the simultaneous machining of 10 pieces.

Hydra-Grip is a hydraulic work holder adaptable to a wide variety of milling operations, and having interchangeable collets that hold the work in accurate alignment for precision machining, on mill-



ing machines, shapers, grinders, or drill presses. The work is dropped into the collets and a few strokes of the hydraulic pump handle brings the pressure to any point up to 4000 lbs; pressure is instantly released by a quarter turn of the release valve, permitting instant unloading.

Collets are available in a full range of sizes from .25″ to 1.25″, to hold round, square, or hexagonal stock. Special sizes or shapes also are available. The controlled wrapping action of the collets insures a tight grip on all 10 pieces, and the equalized pressure holds all pieces uniformly, regardless of variations in size, within normal limits. Accurate control of pressure makes this attachment particularly suitable for holding thin-walled or easily distorted work.

Hydra-Grip is self-contained, has no outside lines or connections, and does not change normal machining practice. It is 29″ long, 5.5″ wide, 6″ high, and weighs 125 lb.

Hydra, Inc., Los Angeles, Calif.

CAPACITOR DISCHARGE RESISTANCE WELDING CONTROL

AeroED 15 (Nov. 1941) . . . A new capacitor-discharge control specially designed for use with resistance-welding machines used for welding aluminum and its alloys.

In the capacitor-discharge method of resistance welding, electric energy is stored in the capacitors of the control by a charging circuit, and then rapidly released into the welding transformer, the resulting current producing the weld. The charging circuit then recharges the capacitors and the operation is repeated.

The control cabinet contains up to 22 capacitors, any number of which can be used at one time. Two special tap switches select the number of capacitors desired in one-unit steps, each of 120 microfarads. By adjusting the voltage output of the control, and by selecting the number of capacitors, welding flexibility is assured.

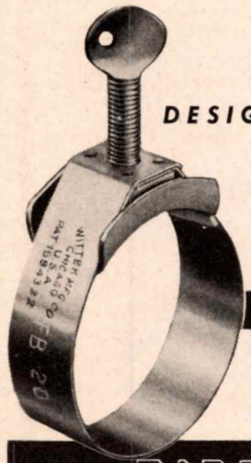
A special circuit which prevents operation of the welding machine if the capacitor voltage is more than 3% below its preselected value, reduces the possibility of insufficient energy to produce good welds. The charging circuit quickly and automatically charges the capacitors, to the preselected voltage regardless of the number used, thus allowing fast welding speed.

A discharge contactor discharges the capacity units remotely by means of a push button if necessary. A manually operated 3-phase circuit breaker protects the anode

(Continued on following page)

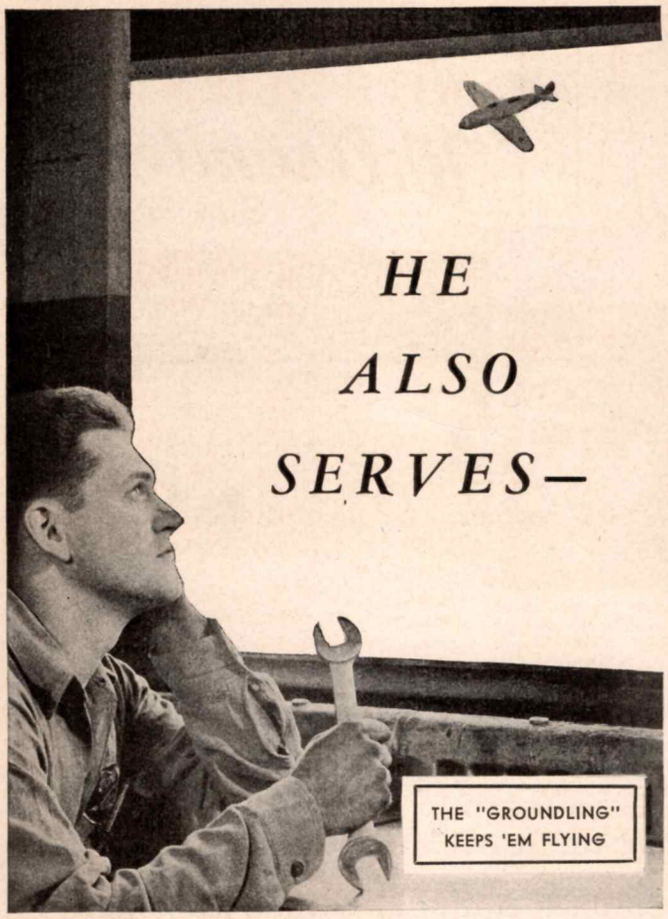
Consolidated Aircraft's "Liberator," the giant B-24 Bomber, in mass production for the R.A.F. and the U. S. Army Air Corps, is equipped with Wittek Type FB Stainless Steel Hose Clamps.

Leading aircraft manufacturers, engine builders, and airlines name the Wittek Type FB as the standard specifications hose clamp.



DESIGNED, BUILT AND TESTED
For Aircraft Use
WITTEK
TYPE FB STAINLESS STEEL
HOSE CLAMP

WITTEK
MANUFACTURING CO.
4305 W. 24th Pl., Chicago, Illinois, U.S.A.



FROM the pride in his eyes as he scans the sky, you wouldn't know he's strictly a groundling.

He never wore a natty tunic emblazoned with wings; never thrilled to pulling out of a nasty spin.

To pilot a clipper, ferry a bomber, mix it up with a swarm of fighters—these things are not in the cards for him.

His cockpit is a workbench; *his* uniform, grimy dungarees; *his* weapons, high-speed wrenches.

But he knows his job, and knowing it well, he also serves—mightily!

WILLIAMS
SUPERIOR DROP-FORGED TOOLS
AVIATION
"SUPERRENCHES" : "SUPERSOCKETS"

J. H. WILLIAMS & CO., *"The Wrench People"*
225 Lafayette, St., New York
Western Warehouse & Office: Chicago Works: Buffalo

(Continued from preceding page) transformer in case of a short circuit. If any of the cabinet doors are opened, interlocks automatically discharge the capacitors through the discharge contactor. In addition, a discharge bar is mechanically operated to short out those capacitors which were in use at that time. The remaining capacitors are shorted by a special tap switch.

General Electric Co., Schenectady, N. Y.

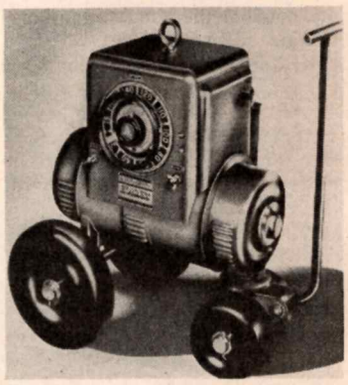
AIRCRAFT ARC WELDING MACHINE

AeroED 37 (Nov. 1941) . . . The *Aircraft Special* arc welder has been produced as a special design arc welder for aircraft construction. Although it embodies the same design and operating speed (1750 rpm) as other Hobart *Multi-Range* arc welders, it has been modified to give the quick, hot start so necessary in welding light gage alloy tubular members. It also provides a lower range of welding current specified from 10 to 150 amp at normal welding voltage.

Characteristics of the machine are ideal for welding all light gage metals that are weldable by the electric arc, especially, X-4130 chrome molybdenum steel.

It also welds especially well with coated electrodes of .0312" to .1562" size, without burning through, and with steady progress along the seam due to the soft arc that hangs on even under low current conditions. Dual control of welding current and open circuit voltage enables the operator to select exactly the right volt-ampere combination for each job. Remote control (standard equipment) makes it possible for the operator to make slight heat adjustments after the hot start without return to welding machine.

Models are available either stationary or portable, the latter having steel wheels, or balloon or hard rubber tires. Furnished with convenient links for voltage changeover from 220 to 440 volts or *vice-versa*, the machine is also supplied for 550 volts and special voltages.



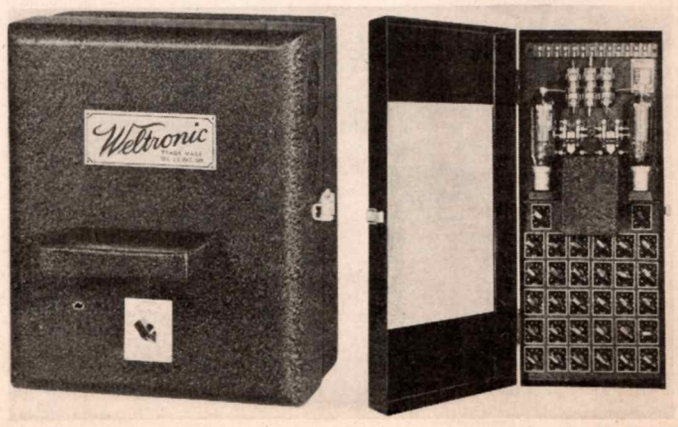
Hobart Bros., Troy, Ohio.

RESISTANCE WELDING HEAT CONTROLS

AeroED 36 (Nov. 1941) . . . A complete line of resistance welding heat controls, designed to accommodate virtually every conceivable application of such units to resistance welding operations.

The various models available are designed to take care of such applications as single-weld operations, using either guns or pedestal type welders; pulsation welding which requires different amounts of current for different shots; and multi-spot welding as with hydromatics, ultra-speed welders, *etc.*, where individual adjustments are desired for each weld or group of welds of the series.

The Weltronic Series 50 line of heat-controls consists of three basic models, the 50-Y unit designed for accurate current control for single welds, the 50-W a multiple heat control designed for either pulsation or multi-spot welding, and the 50-XX which is an auto-



matic heat rise control for either single-spot or pulsation welding.

In addition there are available a number of other models, such as dual and triple heat controls which are fundamentally combination units designed to take care of accurate pre-selective current adjustment for two or three operations performed with the same machine or gun, *etc.*

All Weltronic heat controls are of the electronic type, providing an infinitely variable adjustment of current value. When such heat controls are provided, auto-transformers can be omitted in the welding circuit.

The simplest unit, the 50-Y may be adapted to any resistance welding set-up. It is connected into the circuit directly between the timer (any make may be used) and the electronic contactor. It serves to control the output through the contactor tubes by setting a dial to the current value desired.

For use in multi-point welding, the Model 50-W is provided with a number of dials on the panel corresponding to the number of different welds for which current control is desired. Such a unit is particularly valuable in connection with Hydromatic and Ultra-Speed type welders, both to eliminate the effect of induction on current values and to permit the provision of varying amounts of current for different welds in the same machine cycle, if desired.

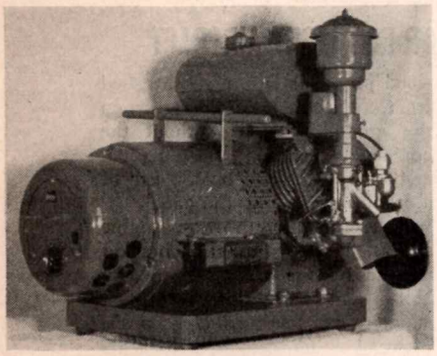
Although the unit provides individual adjustments for each individual weld, only two wires are required to connect it into the welding circuit. This is made possible by the automatic operation of the unit. Dial one on the panel always corresponds to the first weld made by the machine, Dial 2 to the second weld, *etc.*

When the machine has completed its cycle the heat control resets itself, always returning to the "starting point" since its operation is controlled by the functioning of the sequence timer. This multi-weld heat control provides speeds as high as 400 individually controlled welds a minute.

Weltronic Corp., 3080 E. Outer Dr., Detroit, Mich.

500 WATT, 110-VOLT PORTABLE GENERATOR

AeroED 27 (Nov. 1941) . . . A compact, light weight, portable unit



designated Model 23A which generates 500 watts standard 110-volt, 60-cycle, ac or 200 watts at 6-volts dc suitable for battery charging if desired.

It is portable, compact, and rugged; it is an ideal model for sound trucks, trailers, or any other place where 500 watts capacity is all that is desired. It also is ideal for operating lights, radio and small appliances, and can be equipped with remote control or automatic starting upon specification at slight additional charge.

It has a 1 hp Johnson single cylinder, aircooled, engine, is filtered and shielded for radio operation, and will run approximately nine hours on a gallon of gaso-

Kato Engineering Co., 530 N. Front St., Mankato, Minn.

NEW METHOD FOR DETERMINING CLOUD ALTITUDE

AeroED 11 (Nov. 1941) . . . A tiny, 1000-watt mercury lamp for searchlights and television studios has been used to make daylight measurements of the height from the ground of clouds by a new method developed by the Bureau of Standards at the request of the U. S. Weather Bureau.

By projecting the light from one of these high intensity water-cooled quartz mercury lamps, and noting with a photoelectric eye the "splatter" of the light where it hits the cloud, the altitude can be calculated by triangulation.

During the daytime dark overcast clouds at an elevation of 9000 ft have been readily detected. For cumulus clouds illuminated by direct sunlight and having elevations up to 4000 ft, the detection is positive.

The projector consists of the lamp located at the focus of a 24″ parabolic mirror having a 10″ focal length. The electric eye detector consists of a vacuum-type phototube placed immediately behind a diaphragm with a slit opening $\frac{3}{25}$″ × $\frac{11}{16}$″ located at the focus of an 8″ condensing lens.

The narrow beam from the lamp is projected into the sky at a frequency of 120 flashes/sec; the

(Continued on following page)

SAFE GLARE PROTECTION WITH SCIENTIFIC *Willsonite* SUN GLASSES

★

"The unusual glare protection of Willsonite means a lot to me."

Capt. W. E. Larned, UNITED AIR LINES.

★

GOGGLES
RESPIRATORS
GAS MASKS
SUN GLASSES

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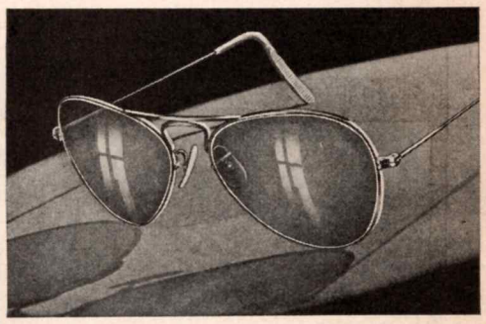


Flight surgeons of leading air lines have approved cool green Willsonite Sun Glass lenses for pilots. Willsonite improves the judgment of distances . . . gives 3 times the protection of ordinary sun glass lenses . . . cuts out 97% of the harmful infra-red rays . . . and eliminates glare from all angles. Ask about Willsonite at your airport or write direct.

DOUBLE WILLSON
PRODUCTS INCORPORATED
READING, PA., U.S.A. *Established 1870*

WHAT ARE WE BID?

BRAND NEW

HARLOW "EXECUTIVE"

Four-passenger all-metal low-wing cabin land monoplane, with retractable landing gear

Powered by Warner 145 H.P. Engine

Contributed to

The Royal Air Force Benevolent Fund

by

The Intercontinent Corporation

100% of proceeds will go to the gallant airmen of the R.A.F. and the Eagle Squadron and their dependents

Direct replies to: The Secretary, R.A.F. Benevolent Fund of the U. S. A., Inc., 515 Madison Avenue, New York, N. Y.

WHAT FELT
would you
specify here?
LOOK BELOW FOR YOUR ANSWER
The BOOTH mechanical felt part in this aircraft application illustrates one of many felt uses . . . classified authoritatively in the valuable reference work pictured below. Can felt be profitably used? What type of felt? These questions are constantly before Design, Production and Purchasing executives. The Booth chart answers them. BOOTH FELT COMPANY, 436 19th Street, Brooklyn, New York, 738 Sherman Street, Chicago, Ill.
COMBINATION
FELT APPLICATION CHART
AND SAMPLE FILE-FOLDER
Of standard file size, it contains actual swatches of the 14 S.A.E. felt types, together with complete reference and specification tables. Write for your copy No obligation . . . no sales follow-up.
1635
Booth

Fourteen years' experience in producing heat-treated aluminum castings

Heat-Treated ALUMINUM CASTINGS for Aircraft

* * *

ALUMINUM PISTONS

Top quality aluminum alloys are produced in our modern laboratory-controlled foundry. We machine pistons to exacting specifications on up-to-date equipment.

RAY DAY PISTON CORP.
West Warren at Walton
Detroit, Michigan

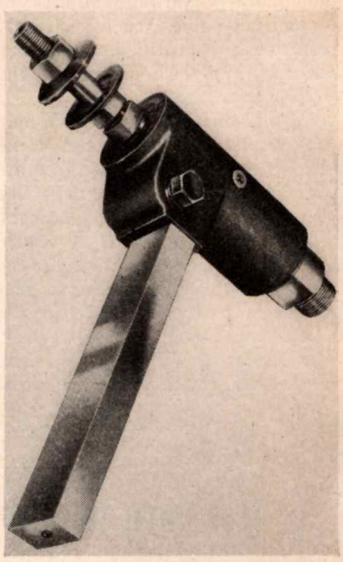
(Continued from preceding page)

rays scatter when they hit the clouds, this light scattering being detected by the photoelectric eye located at a known distance from the lamp and adjusted for this flash frequency, so that will distinguish the beam from background atmospheric light.

Cloud height is obtained by solving for the right triangle formed by the line of the beam to the clouds, the angle of the electric eye sight upon the clouds and the base line connecting the beam projector and the phototube.

General Electric Co., Schenectady, N. Y.

TOOL POST ATTACHMENT FOR GRINDING ON LATHE



AeroED 30 (Nov. 1941) . . . A new tool post attachment for lathes, driven by a portable flexible shaft machine. Permits a lathe to be adapted to many different external and internal grinding operations. The device accommodates grinding wheels up to 6″ diam × 1″ face, and, by removing the clamp spindle and substituting a Stow collet chuck, a variety of mounted wheels and points may be operated for internal grinding and recess surfacing.

On the tool end, the tool post attachment is fitted with a combination radial thrust and annular ball bearing; on the shaft end there is a floating, self-aligning ball bearing. This rigid spindle support insures true running of the unit at speeds up to 6800 rpm.

Stow Mfg. Co., Inc., 443 State St., Binghamton, N. Y.

CONTROLLABLE PITCH PROP FOR LIGHT AIRCRAFT

AeroED 9 (Nov. 1941) . . . All the aerodynamic advantages gained through the use of a controllable pitch propeller are now available to operators of light aircraft with Roby's new development.

Approved by the CAA (ATC 771), the Roby controllable pitch propeller can now be installed on all 80 hp or lower engines of the opposed type having a zero taper shaft. Neat in appearance, compact and light in weight, this wood propeller is easily controlled from the cockpit in flight, or on the ground with or without the engine in operation. Desired pitch angles are obtained by the use of a crank mounted on the panel.

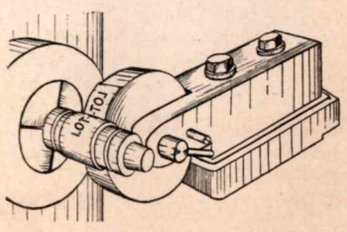
Installation requires no engine alterations; an installation bracket attaches to the crankcase by two bolts, and the control bracket mounts on two cylinder studs. There are no complicated gears or hydraulic lines.

Roby, Inc., 201 N. Sycamore, Wichita, Kans.

TOOL MARKS PARTS DURING PRODUCTION

AearoED 56 (Nov. 1941) . . . Developed especially for marking parts being produced on automatic screw machines, lathes, *etc.*, a rotary or roll type marking device, with solid die is now in production.

As may be noticed from the accompanying illustration, which shows the device in use on an automatic screw machine, the marking roll fits into a holder which has a fine adjustment for starting the marking operation when the roll is brought into contact with the part. After completing the marking operation, the roll is returned to initial position by a coiled spring mounted on the end of the roll shaft. The roll is so designed that continuous contact with the part after marking does not cause it to rotate and re-mark the surface. Only a single impression is made, even though the part continues to rotate be-

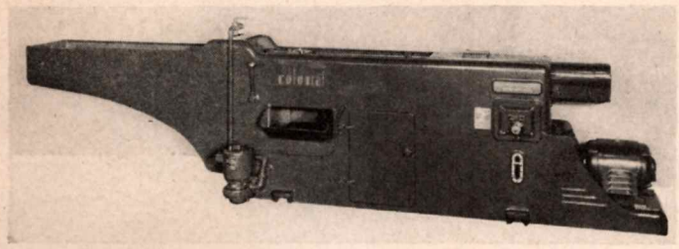


fore the roll is withdrawn from contact.

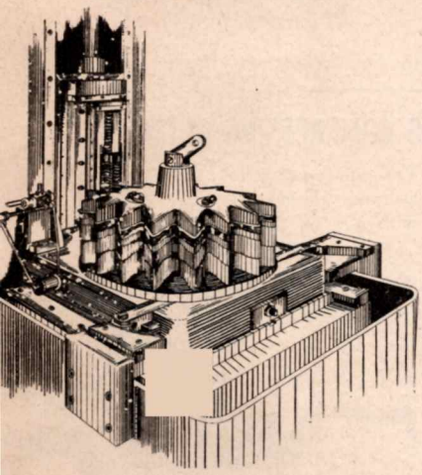
Various forms of holder shanks are available so that the device can be adapted to most applications where the marking of rotating parts in production is required. Another type with interchangeable die has also just been developed.

New Method Steel Stamps, Inc., 143 Jos Campau, Detroit, Mich.

BROACHING SIMPLIFIES SPROCKET PRODUCTION



AeroED 24 (Nov. 1941) . . . Rapid and low-cost finishing of large sprocket teeth in a single operation from the rough cut steel plates or castings is possible with the set-up shown in the accompanying illustration. Crawler sprockets can be accurately broached several at a time by a single pass of the broach.



The platen of the Colonial broaching machine is equipped with an indexing table on which the sprockets are located after boring the hole for the hub. The teeth of the sprockets may first be roughed out by flame cutting if made from steel plates. If production is large enough, the machine may be arranged for automatic indexing. As will be noticed from the sketch, only a single broach is required for finishing the adjacent faces of each tooth well within the limits necessary for parts of this kind.

This installation was designed for use with a single ram type broaching machine of 25 tons capacity, and 66″ stroke, equipped with indexing table.

Colonial Broach Co., 147 Joseph Campau, Detroit, Mich.

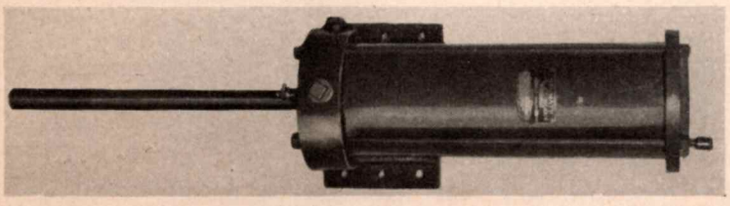
PNEUMATIC COUNTERBALANCES FOR PRESSES

AeroED 26 (Nov. 1941) . . . Model GT counterbalance cylinder for large, straight-side punch press.

These pneumatic counterbalance cylinders operate direct from the air line system in the shop and serve to counterbalance the large rams on the larger straight-side presses, compensating for the increase or decrease in the size of the die tooling equipment fastened to the press ram. This compensator is regulated by a combination regulator and air pressure gauge furnished with each set of counterbalance cylinders.

The counterbalance cylinders are installed in groups of 2, 4 or 6 and automatically take up lost motion resulting from wear of parts and the large clutch mechanisms, which is especially objectionable on large dies both in forming and blanking operations. By the use of these counterbalance cylinders a press operating with a clutch jam may be operated without the use of the retarding brake or with only slight

(Continued on following page)



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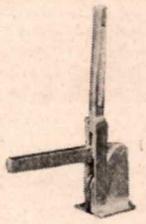

No. 1512 Toggle Clamp

No. 1513 Toggle Clamp (Extended Base)

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PECO Clamps are *Engineered* by Production Men for today's production methods.

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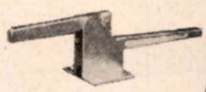
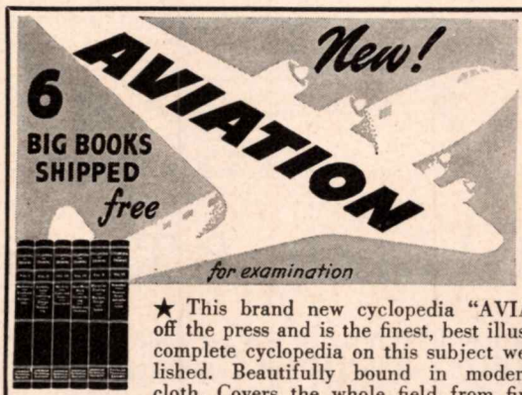


No. 1514 Quick Action Toggle Clamp

PRODUCTS ENGINEERING COMPANY
700 E. FLORENCE AVENUE, LOS ANGELES, CALIFORNIA



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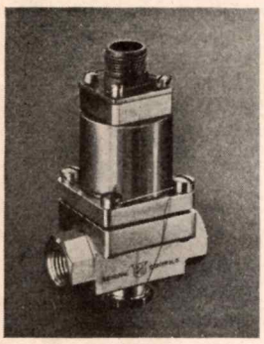

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UTICA DROP FORGE & TOOL CORPORATION
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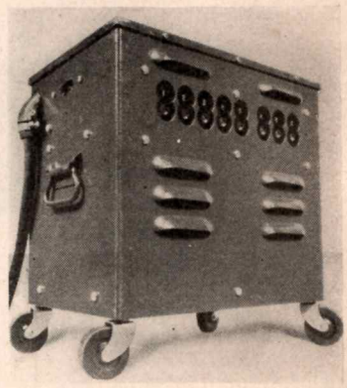
(Continued from preceding page) friction on the brake itself, as the counterbalance cylinders will give the required retarding controlled action. These cylinders are made from 6″ to 14″, having strokes from 12″ to 24″. Both the steel polished cylinders and piston stem are hard chrome plated, preventing rusting and pitting.

Dayton Rogers Mfg. Co., 2830 13 Ave., S., Minneapolis, Minn.

MIDGET MARVEL FLAXARC WELDER

AeroED 29 (Nov. 1941) . . . For use in welding light gauge metal, castings and drive shafts, general maintenance and light production work, a new Flexarc welder has been developed by Westinghouse.



Sensitive adjustment of the welding current over a range from 20 to 140 amp is provided by 15 steps with correctly proportioned increments between steps. Full load rating is 110 amp, 30 minutes, 30 load volts, when used on 220 volt, 60 cycle lines.

The unit is compact, measuring approximately 14.5″ by 12.12″ by 20″ long. Weighing 160 lbs, the

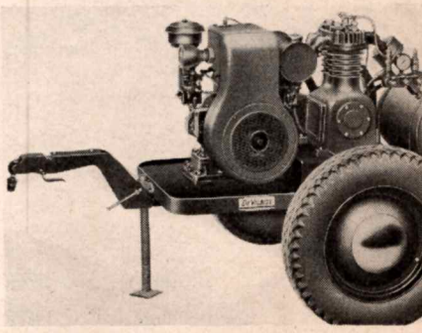
Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

PORTABLE SPRAY PAINTING COMPRESSING OUTFITS

AeroED 38 (Nov. 1941) . . . Two improved series of 4 and 6 hp portable spray painting air compressing outfits, for operation of 2 and 3 spray guns, have just been produced.

Twenty assemblies are included in the series—skid-mounted outfits, rubber-tired and steel wheeled trucks, and two-wheeled trailers. The 6 hp units are available with or without an electric starter, and air or water-cooled engines are optional with this series. These units have twin disc clutch as standard equipment to permit starting of the engine independently of the compressor.

Spray painting equipment for use with the outfits have been set up to be purchased separately from the air compressing outfits. Two-gun equipment is designated as type QM-6016. It may be used with any of the 4 or 6 hp compressing outfits. Three-gun equipment, for use with the 6 hp units, is designated as type QM-6017.



Two-wheel trailer air compressor

DeVilbiss Co., 300 Phillips Ave., Toledo, Ohio.

UNIVERSAL CUTTER RELIEVING MACHINE

AeroED 28 (Nov. 1941) . . . A universal cutter relieving machine designed to simplify and speed production of various types of rotary cutting tools. Suitable for relieving form, gear and rack cutting tools, and milling cutters, spot facers, *etc.*, with radial or side relief or both, it includes features:

Multiple range of forward and reverse speeds to handle virtually all forms of work at maximum efficiency; turnatble for cam slide, permitting relieving from any angle; universal adjustable tool box for quick set-up; quick-interchangeable cams; lubrication from reservoirs with inspection portholes.

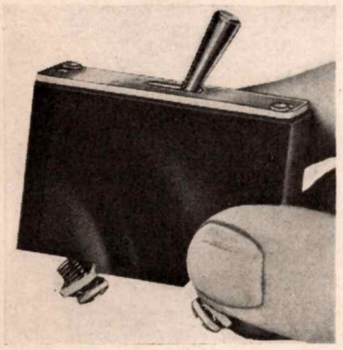
The machine will handle work up to 8″ in diam, with a maximum length between centers of 24″. The number of teeth that can be relieved ranges from 1 to 24, at a maximum relieving stroke of ¾″. Five relief cams are furnished.

Speed changes, both forward and reverse, are obtained through electrical control. Two reversible motors so coupled that by operating either one or both, 7 spindle speeds (4 forward, 3 reverse) are available while the machine is running.

Michigan Tool Co., 7171 E. McNichols Rd., Detroit, Mich.

CIRCUIT BREAKER—"ON"-"OFF" SWITCH

AeroED 76 (Nov. 1941) . . . A new combination circuit breaker and on and off switch for circuit protection on aircraft. Designated Class 9300 circuit breaker, it is



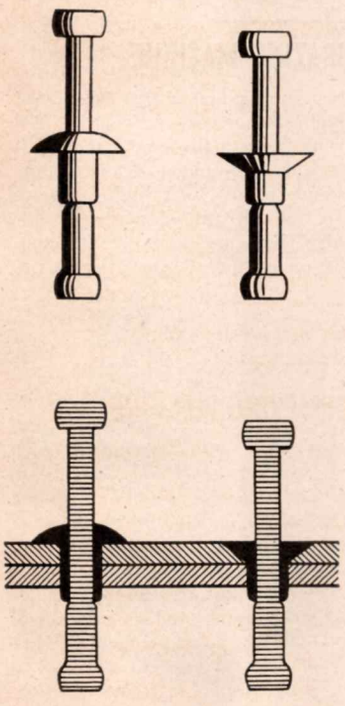
available in a variety of ranges, including 10, 15, 20, 25, 35 and 50 amp sizes, all offered in the same enclosure size $2\frac{1}{16}$" long by $1\frac{33}{64}$" deep by $\frac{3}{4}$" wide. Approved by U. S. Army Air Forces for all uses and by Navy Bureau of Aeronautics for non-trip free requirements. Completely interchangeable with standard "on" and "off" switch, and has $1\frac{13}{16}$" mounting centers using $\frac{6}{32}$" self-locking threads.

This unit saves space, weight and wiring time. It eliminates fuses and provides calibrated protection for each circuit, all within one sealed housing. For *on* and *off* the toggle lever is moved manually as an ordinary switch. Dangerous over current causes the toggle lever to snap to the "off" position. To reset, the lever is merely returned to the on position. 9300 circuit breaker is non-trip free; contact may be manually held closed for emergency but when manualy released, breaker will trip if over-current condition is still present.

Regulator Division, Square D Co., 6060 Rivard St., Detroit, Mich., or Kollsman Division, Square D, Elmhurst, New York.

THE PROBLEM OF BLIND RIVETING

AeroED 81 (Nov. 1941) . . . Blind spots, an old engineering bugaboo, have proved a particularly trying problem in connection with the design of the modern airplane. Engineers have always spent a great deal of time and devoted their ingenuity to the matter of eliminating such hard-to-get-at spots in advance—places which cannot readily be reached from two sides for riveting. Yet it is inevitable, even with careful and time-consuming designing and lay-out, that many such spots are bound to be found in airplane construction.



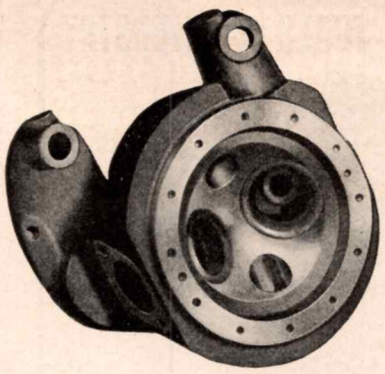
Self-plugging brazier and countersunk rivet assemblies before and after heading-up operation

That is where the Cherry rivet is of use, not only as a solution for true blind spots found in planes designed before these rivets were available, but also at the engineering source.

The Cherry rivet being most widely used in aircraft manufacture is the self-plugging type which has a mandrel with an expanded section and head on the blind side. This expanded section is pulled into the hollow member, expands the shank and forms a tulip head in the back. This operation can be performed with either a hand operated or an automatic gun. The outside end breaks off during application and can be trimmed flush with ordinary nippers. Aircraft factory tests show this type of rivet can be applied and trimmed at the rate of 540 an hour by an unskilled operator.

This discussion deals primarily with the two standard types of self-plugging Cherry rivets — the LS1126 series which is an AD rivet (A17ST aluminum alloy) requiring no additional heat-treatment; head and shank are identical to the new 100° countersunk AN 426 rivet; the plugging stem is made of 17ST aluminum alloy. The LS1127 series which is of

(Continued on following page)



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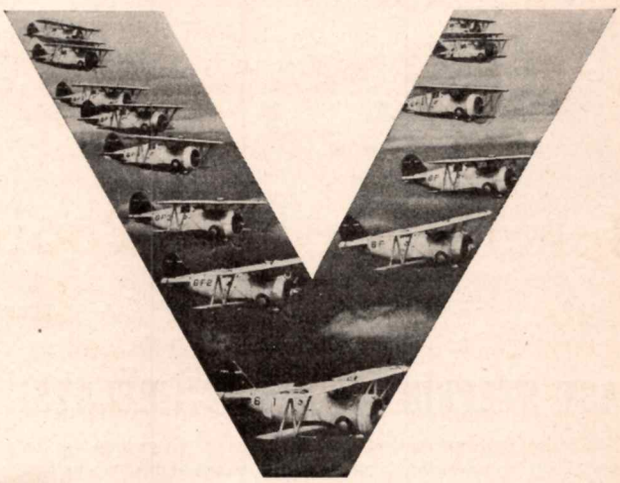

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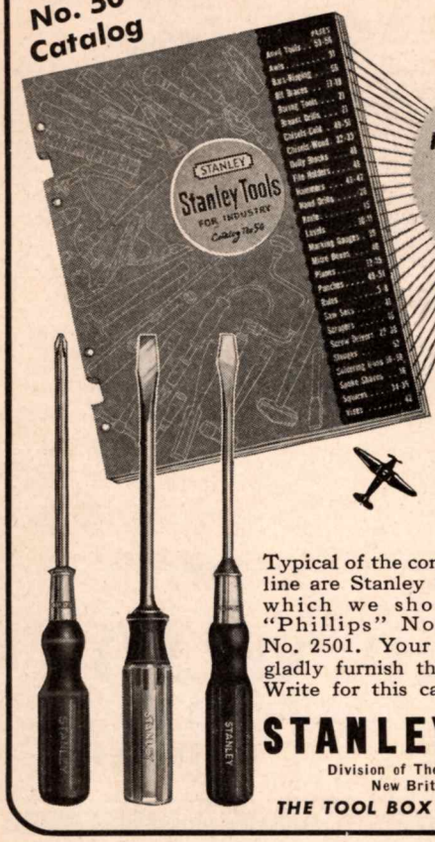

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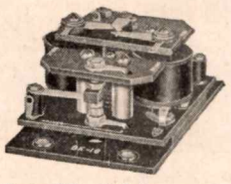

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(Continued from preceding page)

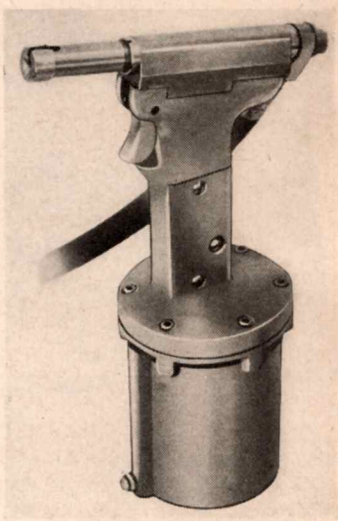
identical construction with LS1126, except that the head and shank have the dimensions of the Western Standards Brazier.

A third type, now nearing production, is the LS1128 series designed primarily for use in double-dimpled construction where the pilot hole size in thin sheets has been greatly enlarged (from .010″ to .020″) over the nominally sized fractional diameter. The head is identical to the AN426 rivet but the shank diameter has been enlarged from .009″ to .016″ over the nominal fractional dimension. Tests indicate that this rivet will bring the shear and fatigue values of the dimpled joint up equal to or better than the equivalent joint with brazier-head rivets; yet it requires no more head space than the fractionally diametered rivet.

The hollow types, LS1112 and LS1113, have a stem or mandrel which breaks and flies out of the rivet when applied, leaving a hollow rivet. If desired the resulting hole in the rivet may be plugged with a knurled drive-in plug.

Various types of Cherry rivet guns are available. Some are manually operated, some pneumatic.

The outstanding feature of the Cherry rivet is its positive mechanical action. When a pull of 300 to 900 lb, depending on rivet size, has been exerted on the mandrel, there is little doubt as to the type of head formed on the blind side. The force required to apply the rivet breaks the mandrel and accomplishes two results. It creates a clinching action, holding the sheets securely together. It also expands the shank of the rivet, causing a pressure fit of the shank. These two features, according to the manufacturer, give the Cherry rivet strength and resistance to fatigue which compares favorably with that of a conventional solid rivet.



Combination hydraulic-pneumatic gun

Cherry Rivet Co., 1819 Barranca St., Los Angeles, Calif.

20 KW INDUCTION BRAZING MACHINE

AeroED 78 (Nov. 1941) . . . Two-station 20 kw (output) capacity *Tocco* Junior electrical induction surface hardening and heating unit, adapted easily to brazing, heating for forging, stress relieving and soldering, as well as surface hardening. It treats small and medium size parts of an unlimited variety, and speeds production. In one instance, 20 engine parts an hour are being induction brazed where formerly 40 an 8-hr day were being turned out by hand.

Development of the new 20 kw unit provides double the production capacity, with no appreciable increase in power consumption, of the original one-station 20 kw Junior. It can operate at full power capacity practically 100% of the time. One operator handles both stations, preparing one fixture as the other is hardening; unskilled labor can be employed.

Typical aircraft uses, among others, to which these machines have been put are brazing tubes, engine accessories, and fuselage parts; and heating propeller hubs for shaping. These are in addition to surface hardening jobs.

A high-frequency motor generator set, supplying 9600 cycles of high frequency current at 220 volts, powers the new machine. It is of all-welded construction, stands about waist high, occupies 36″ × 48″ of floor space. The high frequency generator is mounted on a 3-point suspension to insure level operation. Air filters back up ventilating louvres.

Installation is achieved simply by connecting power and water lines. It is clean, compact, simple to operate, has only one moving part.

Ohio Crankshaft Co., 4000 Harvard Avenue, Cleveland, Ohio

TRADE LITERATURE

WIRE ROPE

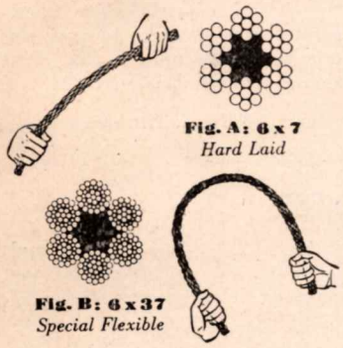


Fig. A: 6 x 7
Hard Laid

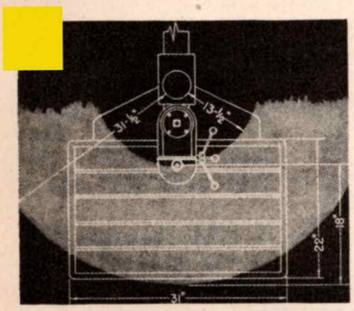
Fig. B: 6 x 37
Special Flexible

AeroED 62 (Nov. 1941) . . . Pointing out that wire rope is subjected to bending fatigue, abrasive wear and loading stress, Macwhyte reports that wire rope is designed either to give most satisfactory service under any one of these conditions, or any combination of them. In a new 4-pg. pamphlet titled *Select the Correct Wire Rope*, the company provides the information necessary to permit the user or designer to specify the correct product for his particular wire rope needs.

Macwhyte Co., Fourteenth Ave., Kenosha, Wisc.

MACHINE TOOLS

AeroED 47 (Nov. 1941) . . . A new and completely revised 56-pg. catalog to explain the standard line of Walker-Turner metal working and wood working machine tools.



Profusely illustrated, the book also shows a number of entirely new machine tools developed primarily for the defense industries. A radial drill press, two polishing lathes and a radial machine for cutting ferrous and non-ferrous metals, plastics and ceramics are featured.

Other machine tools described in the catalog include metal-cutting band saws, radial saws, circular saws, jointers, lathes and similar products.

Walker-Turner Co., Inc., South Ave., Plainfield, N. Y.

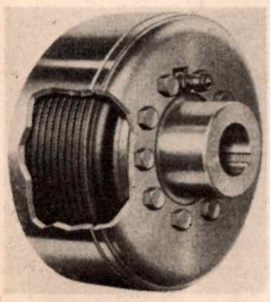
TENSIOMETERS

AeroED 60 (Nov. 1941) . . . Instruments to check the tension of aircraft control cables have been put to important work in the industry and with their increasing use there has arisen an increasing interest in their construction, operation and application.

Circular G covers Air Corps Type C-1 tensiometer, explains its operation and construction. Further use of this lightweight compact device is in measuring the weight of suspended loads, or the magnitude of forces as applied to aircraft testing procedure.

Geophysical Instrument Co., Washington, D. C.

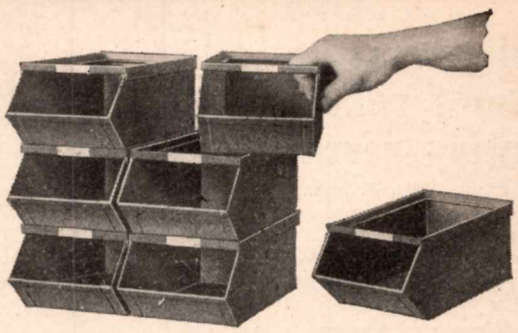
COUPLINGS



AeroED 67 (Nov. 1941) . . . Bulletin No. 8100 fully illustrates and describes the outstanding features of five types of *Airflex* couplings.

In this booklet are contained typical installation views, a complete discussion with example illustrations of the coupling "Rubber Loading in Shear" principle, dimension drawings and tables of each type of coupling. There is also an easy to follow section on how to select couplings.

The Falk Corp., 3001 W. Canal St., Milwaukee, Wis.



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You'll save time, space and labor handling parts and material when you use these patented STACKBINS. STACKBINS keep parts instantly accessible—eliminate waste hand motions — stack compactly to form units of exactly the right shape and capacity—make order filling or assembly work faster, easier, more efficient.

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"STACKED AND STILL ACCESSIBLE"

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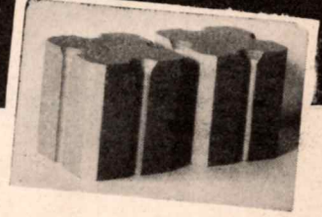

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The severe repeated shocks imposed upon cold header dies require a die steel of unusual stamina and free of the smallest defects which might ultimately result in die failure.

That Jessop "NEW PROCESS" Cold Header Die Steel will stand up under these severe service conditions is demonstrated by the unusually high production from dies such as the one illustrated. In continuous service for 140 hours, it produced 17,000 lbs. of screws before die was worn out.

SEND FOR FREE BOOKLET

We have just published a new 8-page booklet which fully describes Jessop "NEW PROCESS" Cold Header Die Steel. For your free copy, write JESSOP STEEL CO., 610 Green Street, Washington, Pa.

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A·W·FABER·*Inc* NEWARK, N. J.

MODEL No. 830 Midget Toggle Clamp, illustrated above, is the most recent addition to our line of clamping tools. Furnished complete with spindle and rubber cap, measuring but 4" by 1½" high, it is unique in that the pressure obtained by same is in excess of 500 pounds.

Send for new catalog

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16835 HAMILTON AVENUE
DETROIT, MICHIGAN

PANEL INSTRUMENTS

AeroED 65 (Nov. 1941) . . . Miniature ac and dc voltmeters and ammeters in the 2" classification for general use are described in a 12-pg bulletin 43-330. Full scale readings on the de ammeter series are from 20 microamperes to 100 amps and on the ac units, from 5 milliamperes to 50 amps. Voltmeter calibrations are from 5 millivolts to 1000 volts full scale on both ac and dc lines.

Permanent white dials, interchangeability of parts, and high overload capacity are among the features discussed. Operation and construction are described with a note on repulsion vane types for ac circuits.

Typical instruments are illustrated and cutaway views show construction details. A complete tabulation lists rating, scale divisions, style numbers, *etc.*

Westinghouse Electric & Mfg. Co., Dept. 7-N-20, E. Pittsburgh, Pa.

INSTRUMENTS

AeroED 51 (Nov. 1941) . . . A new monthly house magazine featuring articles discussing instrumentation in the aviation and other manufacturing industries.

The publication, *Wheelco Comments*, in the first issue reports a saving of 20% in fuel, labor and reduced spoilage realized by one company following installation of controllers, and gives other information of interest to users and prospective users of industrial instruments.

Wheelco Instruments Co., Harrison & Peoria Sts., Chicago, Ill.

EDGE WOUND RESISTORS

AeroED 53 (Nov. 1941) . . . Two-page leaflet, 12-795, describing edge wound resistors of from 2 to 200 hp for starting and speed regulating duty in wound-rotor induction motors. Different values of starting torque are discussed, and information given for connecting from and to magnetic controllers.

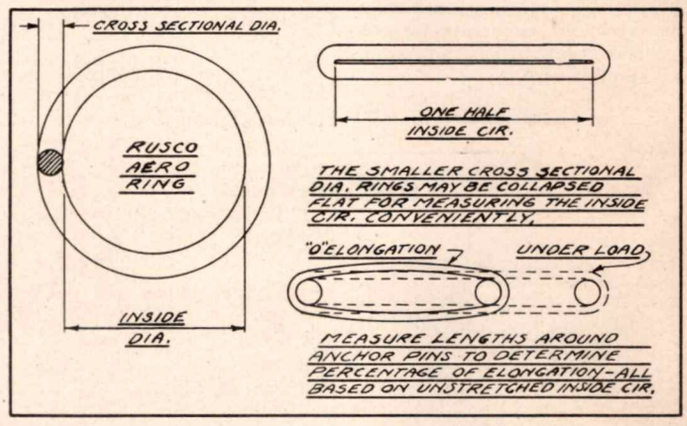
The construction of the resistor has many unusual features that are explained fully. Intermittent duty crane and hoist resistors are also discussed and information on speed control is given.

Ordering information and tabulations give horsepower, prices, shipping weight, *etc.*

Westinghouse Electric & Mfg. Co., Dept. 7-N-20, E. Pittsburgh, Pa.

RUSCO PRODUCTS

AeroED 59 (Nov. 1941) . . . Long a producer of weaved textiles and webbing, and manufacturer of an extensive line of aircraft products, Russell features Rusco Aero Products in a new sales and engineering manual.


CROSS SECTIONAL DIA.
RUSCO AERO RING
INSIDE DIA.
ONE HALF INSIDE CIR.
THE SMALLER CROSS SECTIONAL DIA. RINGS MAY BE COLLAPSED FLAT FOR MEASURING THE INSIDE CIR. CONVENIENTLY.
"O" ELONGATION
UNDER LOAD
MEASURE LENGTHS AROUND ANCHOR PINS TO DETERMINE PERCENTAGE OF ELONGATION - ALL BASED ON UNSTRETCHED INSIDE CIR.

Included in the items covered are elastic cord, rings, shock cord connectors, bungees, safety belts, webbings, friction materials and trumatic shock absorbers. Basic design data is given together with other pertinent information intended to keep the engineer, designer and purchasing agent informed on their choice and use of these products.

Particularly helpful are the installation specifications for aero rings covering practically every type of U. S. aircraft produced.

Russell Manufacturing Co., Middletown, Conn.

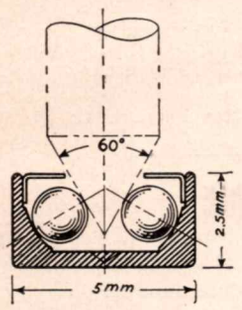
INSURANCE AGENT'S MANUAL

AeroED 50 (Nov. 1941) . . . The first manual ever printed in connection with aviation insurance. A compact pocket-size booklet; contains essential information necessary for handling aviation coverages.

Divided into five different colored sections and well indexed, it includes as an important and unique feature a complete list of aircraft models and their present-day prices. It was prepared essentially to provide agents and brokers with sufficient information concerning aviation insurance to enable them to answer the majority of questions that arise when soliciting aviation risks. Loose-leaf in form, it will be continuously kept up-to-date by the issuance of revision sheets.

Aero Insurance Underwriters, 59 John St., New York, N. Y.

MINIATURE PRECISION BEARINGS



AeroED 61 (Nov. 1941) . . . Catalog 41, 8 pages of data on radial, pivot and special bearings in miniature precision sizes.

Used especially on fine mechanisms and precision instruments, these bearings are finding increasing application in a wide range of such products. Their specifications and other information are given in a section of the booklet reserved for pertinent technical data.

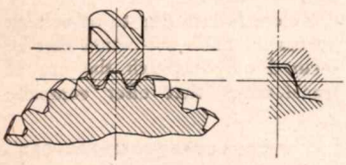
Miniature Precision Bearings, Keene, N. H.

HYDRAULIC EQUIPMENT

AeroED 58 (Nov. 1941) . . . 44-page general bulletin 110-A describing how self-contained, high-speed hydraulic machinery and equipment can help speed production. Divided into two sections for greater reader convenience. Section 1 shows 61 large photographs of hydraulic presses, pumps, jacks, and high-pressure valves with complete descriptive information as to type of unit, use, operating characteristics, dimensions, and other useful information. Section 2 contains selective engineering tables, charts and other useful hydraulic information, much of which is published for the first time.

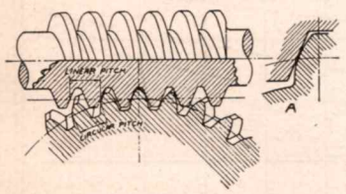
Watson-Stillman Co., Roselle, N. J.

CONE-DRIVE GEARING



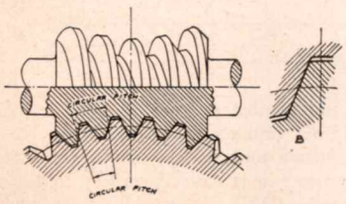
RIGHT ANGLE HELICAL

This type of gearing has only point contact, theoretically, in either plane. This type has but little load carrying capacity.



CONVENTIONAL WORM GEAR

Of the single enveloping type, provides theoretical line contact, with point contact in section. Actually, under load there is of course, some area contact.



CONE DRIVE

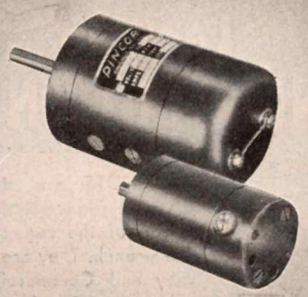
AeroED 66 (Nov. 1941) . . . Two new booklets on cone-drive gearing are now available. The first is designed for executives and others not primarily interested in detailed design problems. The second manual has been prepared for the use of engineers and designers of machinery.

Both booklets contain considerable information not previously published, including illustrations of numerous installations, details on how cone-drives are produced, specifications of speed reducers, and a discussion of gearing in general.

The booklet for executives is entitled *Why Cone-Drive* and carries Bulletin number CW 41B. The design and rating manual for engineers, which also includes complete specifications of standard blanks for worms and wheels, tables of all sizes of ratios for which tooling is available, charts and formulae for computing sizes, stresses, loads, *etc.*, is designated as Catalog CW 41A.

Michigan Tool Co., 7171 E. McNichols Rd., Detroit, Mich.

PINCOR Motors
—for EXACTING REQUIREMENTS



USED WHERE QUALITY IS A NECESSITY

Leading manufacturers of precision equipment *specify* PINCOR D. C. Motors. Particularly recommended for radio band-switching and antenna reels, for the operation of aircraft landing flaps and other equipment, PINCOR Motors may be furnished for a vast variety of other special purposes. Write or wire your requirements. PINCOR engineers are at your service.

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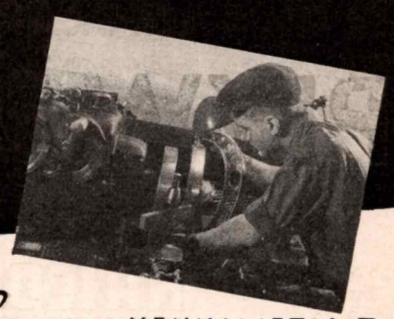
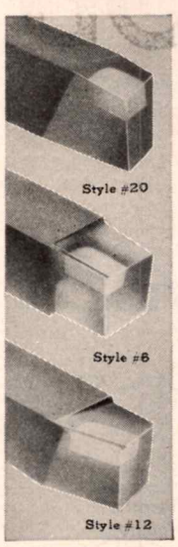
This Man and This Machine are Producing More





Because a KENNAMETAL Tool is in the Tool Post

The cast steel gear blank on this job is machined in 21 minutes less floor-to-floor time because KENNAMETAL tools are used in the turning, boring, and facing operations. The tool cost per part machined is reduced 61%, and total cost is reduced 24%. Details will be sent upon request.

If you wish to get maximum production from your lathes and boring mills—and from the men who run them — investigate KENNAMETAL. Quick deliveries are made on Standard tools and blanks. Write for our new Catalog No. 42.

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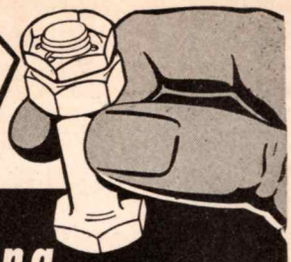
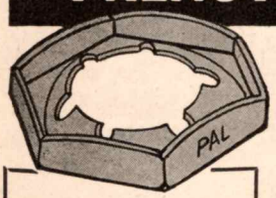
214 LLOYD AVE., LATROBE, PENNA.
FOREIGN REPRESENTATIVES: U. S. STEEL EXPORT CO.
(Exclusive of Canada, Great Britain and Possessions)

A "Little Giant" for HOLDING POWER!



Double Locking
PALNUT LOCKNUTS



Double Locking Action
When the PALNUT is tightened, its arched, slotted jaws grip the bolt like a chuck, while spring tension is exerted upward on the bolt thread and downward on the regular nut, permanently locking both.

● PALNUTS are single thread locknuts of hardened spring steel, tightened on top of the regular nut with 1/3 turn of a wrench. They are standard on Army, Navy and Commercial aircraft engines and accessories because they provide unfailing security under vibration—are extremely light and small—easy and fast to assemble—easily removed and used again—interchangeable with other approved devices—withstand high temperatures—and are very low in cost. You can buy PALNUTS at all airports and leading aircraft supply houses—or write us for samples and details.

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Manufacturers of Locknuts and Self-Locking Nuts
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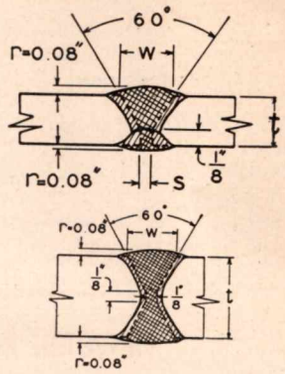
ELECTRODE COST CALCULATOR

AeroED 49 (Nov. 1941) . . . Cost of arc welding electrodes can now be estimated rapidly for welding any type of joint on any thickness with either bare or coated electrodes by the use of a new electrode consumption calculator. This helpful booklet tells how many pounds of electrodes are required per linear foot of weld. The calculator includes consumption figures for both bare and shielded arc electrodes on all metal thicknesses commonly employed in making fillet welds, square groove butt joints, V and U groove butt joints, bevel grooves and J grooves. The amount of steel deposited per linear foot of weld is also shown.



As a further aid on other joints not shown, the basic formulas used in these calculations are included.

Air Reduction, 60 E. 42 St., New York, N. Y.

WELDING CABLE

AeroED 52 (Nov. 1941) . . . Catalog section 26-630, describing FlexArc welding cable for work leads and electrode holders. Flexibility, durability, and other features are discussed. The application of electrode holder cables is described and their construction noted.

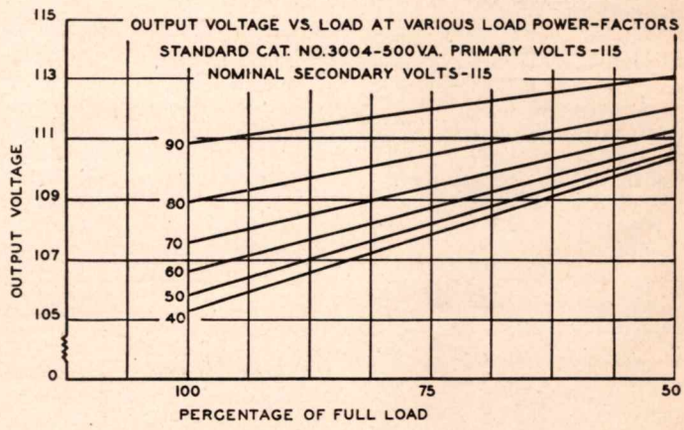
Tabulation gives welding currents of from 50 to 700 amp and voltage drop per 100 ft for cable sizes of from 3 to 4/0. Use of the table is explained by tracing the procedure involved in solving a typical welding cable selection problem.

The cable is offered in two sizes; the smaller to cover a range up to 300 amp, the larger for current values above 300 amp. Uses for the two sizes are explained. List prices, quantity discounts, delivery and terms are given.

Westinghouse Electric & Mfg. Co., Dept. 7-N-20, E. Pittsburgh, Pa.

LIGHTING and PRODUCTION

AeroED 45 (Nov. 1941) . . . At no time in our history has there been such a heavy demand for precision instruments and manufacturing equipment. Coupled with this has been an acceleration of industry to cope with the demands of our national defense program. goes forward without interruption it is necessary that precision electrical equipment be protected against damage, disruption or complete failure due to off-voltage operation. Such protection can be secured only through the use of transformers that offer complete



Electrical power lines, in most cases, are being taxed to capacity, often making line voltages uncertain and undependable. To insure that our national defense program independence from the effects of line voltage variations. How industry and science can meet this situation is fully described in Bulletin CV-74; 24 pgs.

Sola Electric Co., 2525 Claybourn Ave., Chicago, Ill.

WELDERS

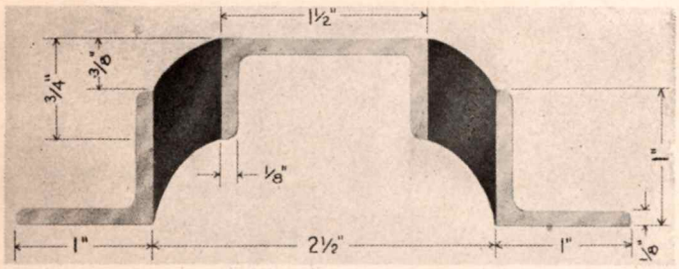
AeroED 46 (Nov. 1941) . . . Flex-arc a-c welders for every type of welding job ranging from light gauge sheet to sustained, heavy duty industrial fabrication are described in a new 8-page bulletin. Current ranges of these welders extends all the way from 20 to 625 amp.

Improvements in a-c welder construction are discussed with a note on new type electrodes. Hints on the selection of a-c welding equipment include descriptions and ratings of the units. The bulletin B-2285 is well illustrated to make explanations of the welder parts easy to follow.

Westinghouse Electric & Mfg. Co., Dept. 7-N-20, E. Pittsburgh, Pa.

VIBRATION INSULATION

AeroED 64 (Nov. 1941) . . . Stripped of highly technical descriptions of the problem of isolating vibration in machines. A 12-pg catalog covers Vibro-Insulators, the devices of metal and rubber which have found wide acceptance in combatting the vibration and noise problem.



Excellently illustrated, both with actual installation pictures and engineer's drawings of each type of Vibro-Insulator which it manufactures, the catalog section gives pertinent information on each.

The first two pages give a general discussion of the vibration insulation problem and the part that rubber is playing in its solution. Methods of selecting the proper Vibro-Insulator mounting are given, together with methods of mounting, and discussions of uniformity of load distribution, rocking and horizontal motion and the care of the devices.

Applications of the mountings on various types of equipment are listed, together with a table of characteristics. Nine pages are devoted to listing of the fundamental data for each type of mounting, together with an engineer's drawing of each.

B. F. Goodrich Co., Akron, Ohio.

DATA ON SYNTHETIC RUBBER

AeroED 55 (Nov. 1941) . . . 8-pg. catalog featuring four tables which contain data enough to answer almost any question on Ameripol D synthetic rubber used in making mechanical rubber products.

First of the tables compares the properties of Ameripol in 33 specific respects starting with "workability" and ending with "resistance to paint and ink dryers" with natural rubber and two other types of synthetic rubber, giving the rating of each.

The second table lists the prop-

(Continued on following page)

Per Cent Volume Increase After 48 Hrs. Immersion

Liquid	Temperature	Natural Rubber (Tread Stk.)	Ameripol Hose Tube	Synthetic A Hose Tube	Synthetic B Hose Tube
Light, penetrating oil*.	212° F.	381	0	69	13
95% Kerosene, 5% Benzene..	212° F	483	0	80	54
Hexane	Room	147	0	16	1.5
Benzene (Benzol)	"	206	105	180	100
Carbon tetrachloride	"	262	26	142	30
Cracked gasoline **	"	173	1.5	34	2
Alcohol (95% Ethanol)	"	3	3	0	.75
Water (distilled)	"	3	0	0	2
95% Kerosene 5% Benzene	"	153	0	37	2
Lubricating oil S A E - 20.	"	30	0	0	0

*Sun Oil Co. Circo Process Oil Light. Has most severe swelling effect on rubber of any mineral lubricating oil

**Standard Oil X-70.

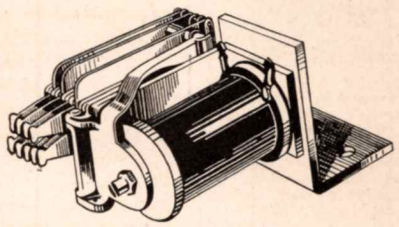
AUTOMATIC ELECTRIC RELAYS

CONTRIBUTE TO CURTISS-WRIGHT DEPENDABILITY

● Automatic Electric relays and stepping switches, as well as Tell-Tale units that automatically check the functions of major instruments and controls, contribute to the safety and efficiency of Curtiss-Wright CW-25 and C-46 airplanes.

These Automatic Electric products are backed by the "know how" gained from 50 years of manufacturing experience. Our aviation relays, for example, have special features that enable them to withstand successfully an unusual amount of vibration.

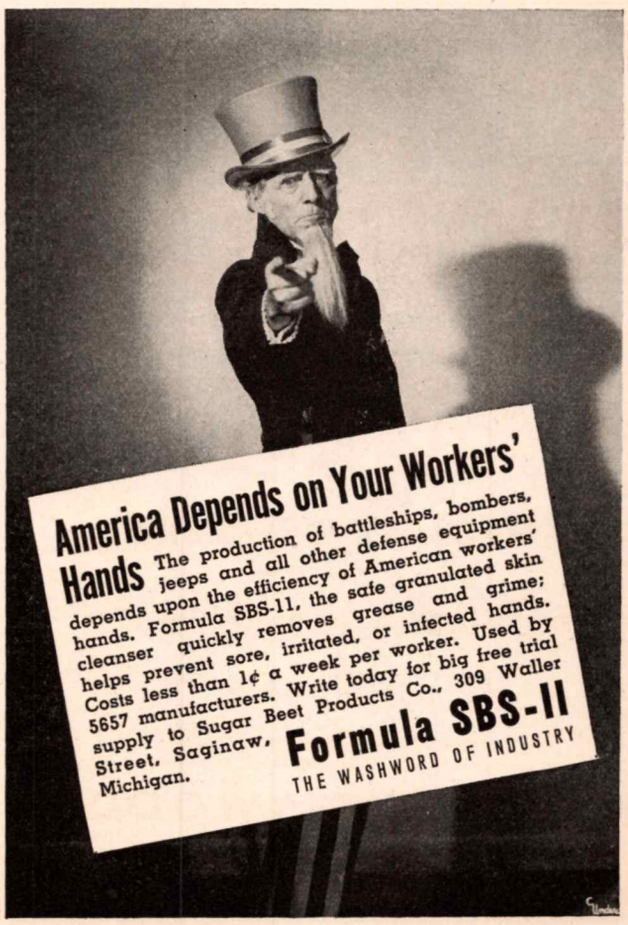
You'll find our comprehensive catalog of relays and related items a valuable source of information. Send for your free copy.



AMERICAN AUTOMATIC ELECTRIC SALES COMPANY
1033 W. Van Buren Street, Chicago

AUTOMATIC ELECTRIC

RELAY MAKERS SINCE 1898


America Depends on Your Workers' Hands
The production of battleships, bombers, jeeps and all other defense equipment depends upon the efficiency of American workers' hands. Formula SBS-11, the safe granulated skin cleanser quickly removes grease and grime; helps prevent sore, irritated, or infected hands. Costs less than 1¢ a week per worker. Used by 5657 manufacturers. Write today for big free trial supply to Sugar Beet Products Co., 309 Waller Street, Saginaw, Michigan.
Formula SBS-II
THE WASHWORD OF INDUSTRY

FLARES
INTERNATIONAL offers the only complete line of Landing Flares approved by the Civil Aeronautics Administration to meet all weight classification requirements.
Landing Flares, Signal Flares and special pyrotechnic equipment built to specification for military and commercial aviation. Specify INTERNATIONAL for safety and dependability.
Write for complete catalog.
INTERNATIONAL FLARE - SIGNAL DIV.
of THE KILGORE MFG. CO., Tipp City, Ohio

AVIATION DEVELOPMENTS LTD.

of Welwyn Garden City, Herts, England, who have successfully launched the

CHOBERT SYSTEM of BLIND RIVETING

on British and Colonial markets

OFFER

the facilities of their organisation for marketing

TO THE ENGINEERING AVIATION AND AUTOMOBILE INDUSTRIES

in these territories

★

Enquiries are solicited for new ideas or established U.S.A. products suitable for manufacture and/or sale in Great Britain and the British Empire.

(Continued from preceding page)

erties of typical Ameripol D vulcanized compounds, including Shore durometer hardness, percentage of elongation at break modulus at 300% elongation, ultimate tensile strength, rebound elasticity, compression set and abrasion resistance index. It also lists the results on each type of compound of 48 hours' immersion in fluids which have a solvenizing effect on natural rubber, ranging from hexane to penetrating oil.

Table three gives the percent volume increase after 48 hr immersion of natural rubber and two other types of synthetic rubber, as compared to Ameripol D, while the fourth table is a rough guide to determine the service where the use of Ameripol D is practical.

Well illustrated with pictures showing mechanical rubber products made with Ameripol D, the folder discusses in detail its properties, hardness, tensile strength, elongation, weight, color, odor and taste, elasticity and permanent set, tear and abrasion resistance, and resistance to flexing, oils and solvents and heat.

B. F. Goodrich Co., Akron, Ohio

* * *

AeroED 56 (Nov. 1941) . . . Booklet offering all technical data about the new Ameripol synthetic rubber products for sealing airplane hydraulic systems. Physical properties, percent volume increase, hardness readings, comparison tests, fluid immersion test, are covered in this handy reference booklet.

Miller Rubber Co., Akron, Ohio

TUNGSTEN CARBIDE TOOLS

AeroED 57 (Nov. 1941) . . . Instructional material covering virtually every conceivable factor connected with the use of tungsten carbide tools, much of it previously unpublished.

Primary purpose of the manual (GT-133) is to assist defense industry. As the result of current pressure for increased defense production, many companies have been turning to carbide tools, while thousands of operators now being employed by industry are being put to work with carbide tools for the first time.

It is to meet these conditions—to speed the instruction of new operators, to facilitate the design, brazing, use and maintenance of carbide tools by new organizations, that the manual has been prepared.

Not only does it cover the design of carbide tools themselves—the selection of tool shapes, tip and shank sizes, relief angles, *etc.*—but it also covers such related items as design and setting of tool holders, machine recommendations, tool holder screws, correct methods of using coolants, *etc.*

For manufacturers desirous of producing their own tools, the manual provides complete instructions on torch brazing technique, materials, and equipment.

There are complete charts of recommended feeds, speeds, tool angles and depth of cut, for various materials—steel, ferrous castings, non-ferrous and non-metallic.

For the tool room there are complete instructions for grinding tools, including recommendations as to machines, wheels, grinding technique and the design and grinding of chip breakers for tools used in steel-cutting.

Designed to simplify the carrying of tool stocks and enable faster securing of materials, the manual contains numerous illustrations of examples of how special tools can be produced from "standard" tools by simple grinding operations.

A summary of various grades of carbides is included to assist Tool Engineers in selecting the proper grades for different jobs.

In addition to a valuable list of "Do's and Don't's" for carbide tools, there are provided sketches of handling equipment found valuable in preventing accidental damage to such tools.

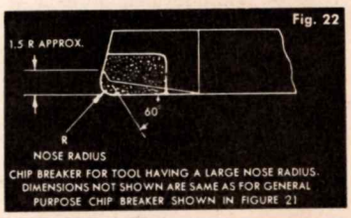


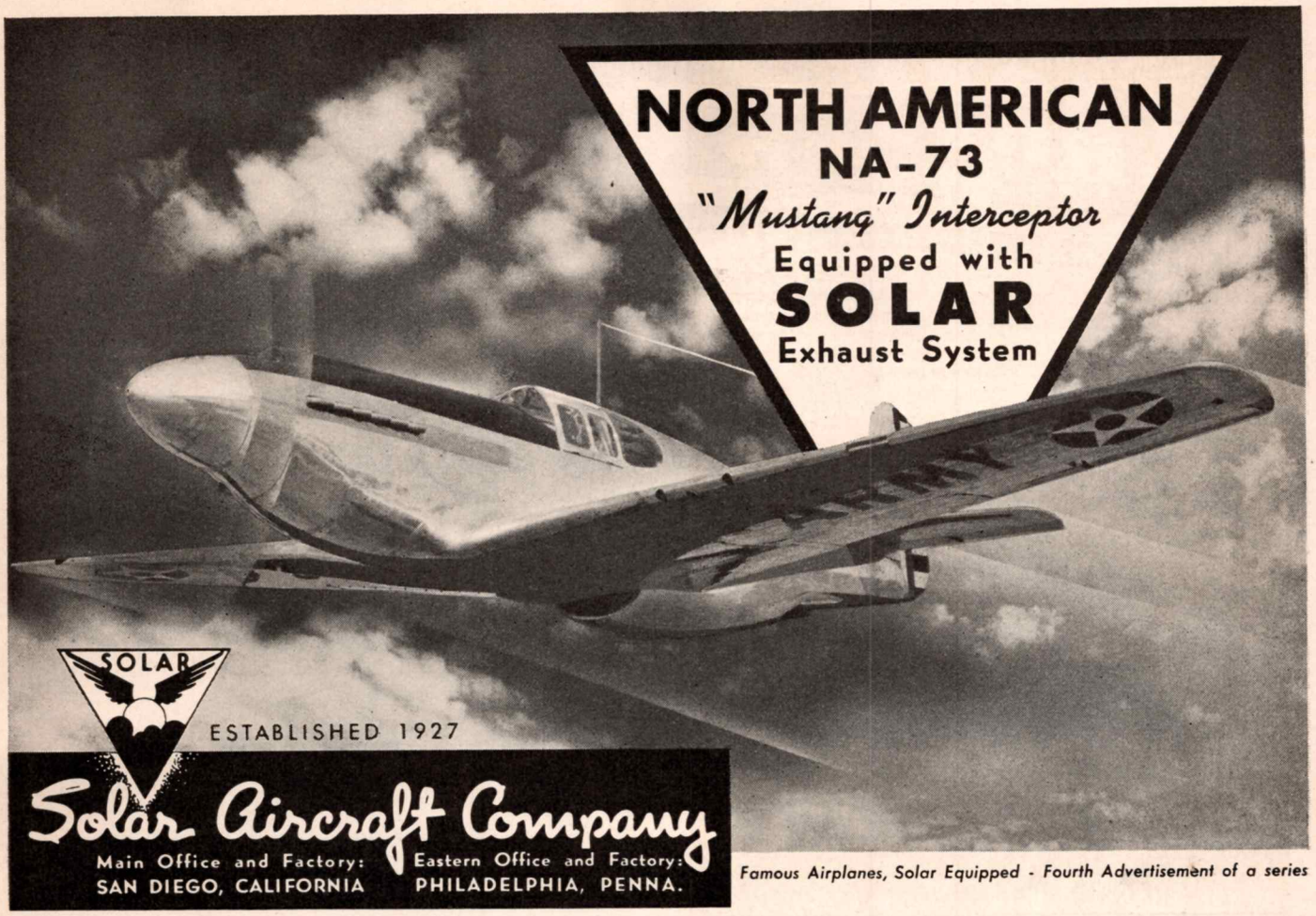
Fig. 22
1.5 R APPROX.
60°
R
NOSE RADIUS
CHIP BREAKER FOR TOOL HAVING A LARGE NOSE RADIUS. DIMENSIONS NOT SHOWN ARE SAME AS FOR GENERAL PURPOSE CHIP BREAKER SHOWN IN FIGURE 21

Fig. 24
W
.015
.030
CHIP BREAKER FOR CUTS EXTENDING TO SHOULDER OR WHERE IT IS DESIRED TO FORCE THE CHIP AGAINST THE WORK AND CAUSE IT TO BREAK

The manual even contains suggestions as to the setting up of tool control and handling methods in the shop with illustrations of tool record cards, *etc.*, based on a survey of best current practice in this respect.

While some of the material contained in the manual has been available previously in various forms, much of the content is new and published for the first time, having been compiled to make the manual complete in every respect.

Carboloy Co., Inc., 11177 E. Eight Mile Rd., Detroit, Mich.



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is strengthened by dependable

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BENDIX AVIATION CORPORATION • SIDNEY, NEW YORK

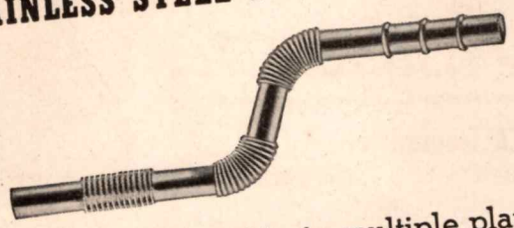
BENDIX SCINTILLA

The world's finest aircraft ignition

FLEXIBLE CONNECTIONS, FLEXIBLE CONDUIT AND FITTINGS FOR THE AIRCRAFT INDUSTRY

REX-FLEX

STAINLESS STEEL FLEXIBLE TUBING



Weighs less. Bendable in multiple planes. Available in long lengths. Corrugated at desired intervals. Four separate corrugated forms. May be made up in combination incorporating all forms. Sizes (I.D.) 3/8" to 5". Pressure to 835 p.s.i.

Absolutely tight fitting attachments, resistance seam welded to tubing ends.

Shielding Conduit
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(Also synthetic covered)

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Shielding Conduit Fittings

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Fuel and Oil Line Hose
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Hydraulic Hose
(Cellu-Lined)
Burst pressure to 23,000 p.s.i.
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★

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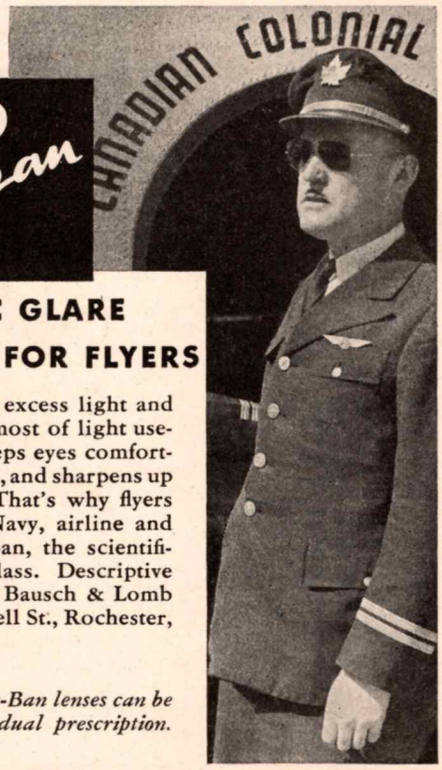
BAUSCH & LOMB Ray-Ban

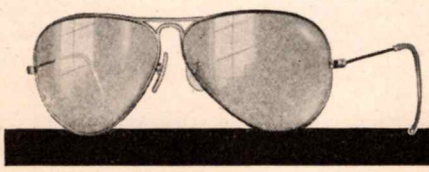


IS SCIENTIFIC GLARE PROTECTION FOR FLYERS

• Ray-Ban filters out excess light and glare—yet transmits most of light useful for seeing—so keeps eyes comfortable, without eyestrain, and sharpens up keenness of vision. That's why flyers everywhere—Army, Navy, airline and private—prefer Ray-Ban, the scientifically correct sun glass. Descriptive literature on request. Bausch & Lomb Optical Co., 234 Lowell St., Rochester, New York.

•

If you wear glasses, Ray-Ban lenses can be ground to your individual prescription.



Captain Randolph E. Churchill, Canadian Colonial Airways

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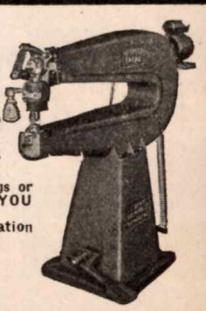

Libert Hi-Speed SHEAR

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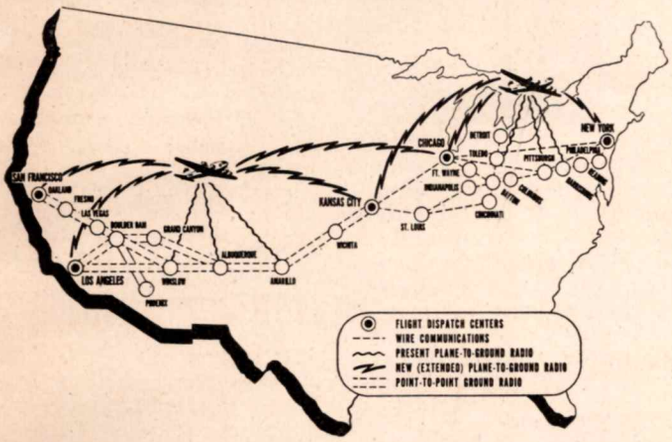
See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

AERO Radio DIGEST

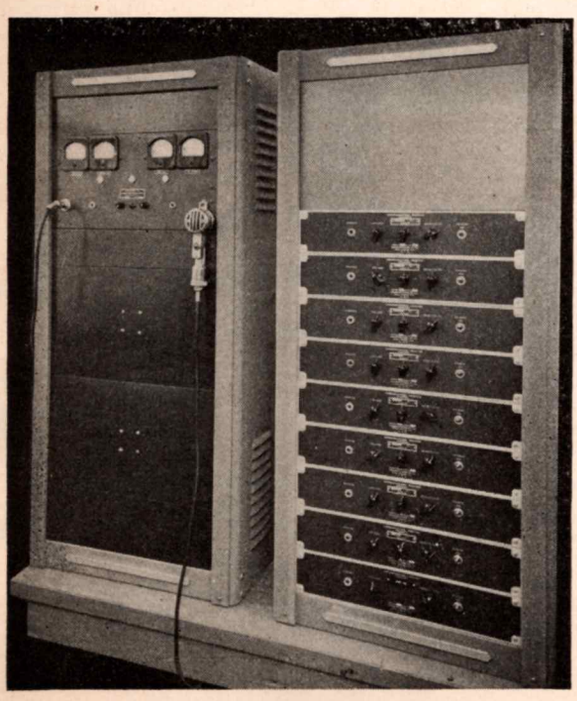


The light wave line shows present plane-to-ground radio range; the darker zig-zag line denotes extended range made possible by use of new frequencies

Higher Frequencies

TWA, Inc. have recently been licensed by FCC to use frequencies of 6510 and 10125 kcs. on their aircraft radio stations. Inclusion of these considerably higher operating frequencies in TWA's aircraft equipment will permit the company to communicate over much greater distances from plane to ground than has heretofore been the custom. Tests made recently with current types of equipment provided good daylight communication over a range of about 1200 mi. as compared to the 500 mi. average heretofore obtainable.

As TWA are engaged in replacing their earlier Model W4A aircraft communication equipments with the new Arinc-Bendix two-way transmitter-receiver units, the addition of these new frequencies to their aircraft will involve merely the addition of crystal units.

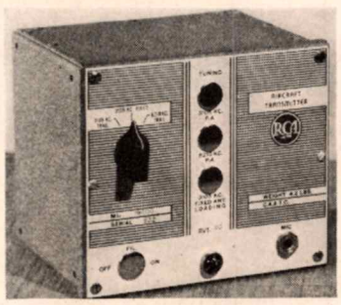


Communications Model 127A transmitter and 82-A receiver

RCA Transmitter

RCA recently announced the AVT-110/111 aircraft transmitter designed especialy for use in small light aircraft. Designated as AVT-110 when dry battery powered, and AVT-111 when storage battery powered, the unit measures $6\frac{1}{8}'' \times 4\frac{27}{32}'' \times 5\frac{1}{4}''$. Dry battery power supply for the AVT-110 brings the weight to 14.7 lb, while the power supply unit for the AVT-111 adds 9 lb to bring the total weight to 13.2 lb. The AVT-111 power supply unit measures $7'' \times 5\frac{1}{4}'' \times 5\frac{1}{2}''$. The AVT-110 supplies 1.5 watts of power, and the AVT-111 6 watts; both operate on 3105 and 6210 kcs.

Six different possible mounting arrangements are provided. The chassis is removable through the front of the case. Remote control



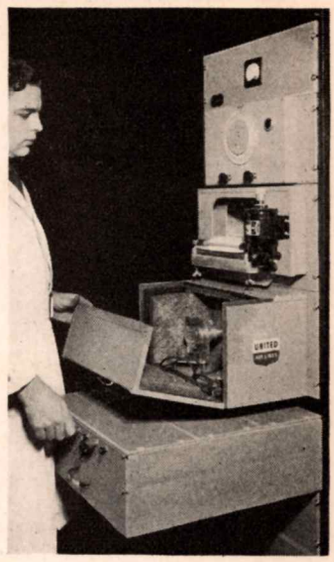
of the transmitter is available by optional installation of a remote control panel.

It is claimed that one of the most important developments of the transmitter is the use of permeability tuning circuits to insure high efficiency and permanence of tuning adjustments under vibration and extremes of temperature and humidity.

This transmitter incorporates a built-in antenna loading coil and provision is made on the frequency selector switch for operation through the loading coil on fixed antenna for ground transmission or, with loading coil omitted, into trailing antenna in flight.

Miami Installation

Communications Co., Inc., Coral Gables, Fla., has supplied a 278 kc Model 127A transmitter and Model 82-A receiver to the Miami Municipal Airport. This apparatus is now installed in a temporary control tower.



UAL microphone and headset tester

Testing Equipment

Latest development of the Communications Laboratory of United Air Lines for use in air transport equipment maintenance is a man-made voice and ear for testing microphones and headsets used in connection with two-way radio telephone communication between United's Mainliners and ground stations.

Actually, the "voice" is a special type of loud speaker connected with an oscillator which produces electrical waves. The loud speaker has a "mouth" and metal tube arrangement similar to the sound passage of a human being. The "ear" is a special microphone embedded in rubber channels which resemble the inner structure of the human ear.

In testing a microphone, an operator places it in front of the "mouth" and the output of the microphone is measured on a recording device. In a headphone test, the headphone is connected with the oscillator and clamped to the "ear" which automatically records the headphone's sensitivity.

Radio

Spartan Aircraft Co., Tulsa, manufacturers of the Waller Communicator line of aviation radio apparatus, have just released a bulletin describing in detail the Waller Communicator line which includes transmitters, receivers and accessories for aircraft and equipment for ground radio stations.

* * *

Lear Avia, Inc., of Dayton, Ohio, have just released a pamphlet describing in detail the T-30-AB aircraft radio transmitter and its companion Type RCBB aircraft radio receiver. This pamphlet also describes the several accessories involved for this small and light aircraft radio apparatus.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

Western Electric's production line now delivering PAA's new transmitters

WE Transmitters

At the rate of twenty a week, upwards of 300 radio transmitters, designed for ground-to-plane communication, are rolling off the assembly lines at Western Electric's Kearny, N. J., Works for delivery to Pan American Airways. These transmitters will form a vital part in Pan American's communications system which links the Boeing Clippers to terminals in the U. S., Alaska, South and Central America, Africa, New Zealand, the islands of the Pacific, and the Far East.

The transmitters are of the 300-400 watt class, and were designed by Bell Telephone Laboratories to Pan American specifications.

Kenyon Transformer

The Kenyon Transformer Co., Inc., Bronx, New York City, have developed a new transformer designated Type T-211. Housed in a standard 4A case, it is designed especially for use with the new RCA 931 Electron Multiplier Tube.

Specifications on this new transformer follow:

Primary: 0/105/115/125 volts, 60 cycles

Secondary #1: 0/100/200/300/400/500/600/700/800/900/1000 volts at 10 MA R.M.S.

Secondary #2: 2.5 volts at 1.75 amp.

Mobile Radio Unit

Jefferson-Travis Radio Manufacturing Corp., New York City, have just produced a new mobile, two-way radio communication unit for use in airport crash trucks, ambulances, and fire trucks as well as in other types of military and commercial vehicles.

This new model, known as the M-10, is enclosed in a cabinet measuring 19" long, 9" high and 8" deep, weighing 28 lbs. complete, and designed for shock mounting in a number of positions. It is a 10 watt, crystal controlled transmitter and receiver built for operation on one to four frequencies in the range of 2000-6000 kcs. Power supply operates from the vehicle's 6-volt storage battery with a maximum current drain of 80 watts while transmitting.

M-10 is equipped with both a telephone handset and a loudspeaker and calls may be transmitted through either by means of a simple switch arrangement. Used with an extension cord, remote control operation is effected by the press-to-talk button in the handset. Simplicity of operation and design is the keynote of this equipment, only four controls being used in its operation.

Jefferson-Travis Model M-10 mobile radiotelephone unit

New Equipment for United

Looking forward to the use of static-free ultra-high frequencies for plane-ground and plane-to-plane communication, United Air Lines has ordered 100 new ARInc-WE Co. combination transmitter-receivers and is making extensive flight tests of uhf plane antenna.

The transmitter-receivers, being purchased at a cost of approximately $100,000 are in addition to a similar number of receivers ordered some time ago for use in connection with ultra-high frequency radio range stations, according to J. R. Cunningham, director of communications for United.

Flight tests of the new-type antenna to be used in ultra-high frequency radio communication have been in progress aboard United's flight research plane under the direction of the company's communications laboratory in Chicago. P. C. Sandretto, laboratory superintendent, reports that excellent results have been obtained with stainless steel vertical rods, 20 inches high and a quarter of an inch thick, which are similar in appearance to automobile antennas. He pointed out that these are extremely small and simple in construction as contrasted with earlier-type antennas which, used for similar purposes but on the present medium-high frequencies, range in length to more than 50 feet.

New Radio CAATC's

Twenty-two aircraft radio type certificates were issued by CAA during the months of August and September, bringing the total of certificates issued to date to 452:

Bendix Radio Corp.

RA-10C aircraft receiver
RA-10D aircraft receiver
MN-24A bearing indicator
MS-18C headphone jack box

RCA Mfg. Co.

12 V DC power unit, part No. 646622
MK-1 automatic direction finder receiver, part No. 645744

Pan American Mfg. & Supply Corp.

R-263 receiver control panel
R-264 volume control panel
RC-314 receiver output switch panel
R-265 cockpit control panel
R-265C cockpit control panel
OCP-314 transmitter control

Bliley Electric Co.

AR4W crystal unit
AR5W crystal unit

Eastern Air Lines

CES-222 aircraft radio marker-beacon control unit
CES-297 apparatus mount

TWA, Inc.

103-C control unit
103-CG coffee grinder

Sperry Gyroscope Co.

645772 dual indicator
645920 control unit and indicator

Automatic Electric Co.

26 airplane microphone

Doolittle Radio, Inc.

Mounting rack type D-10167

Lear Avia Offices

Sydney M. Nesbitt, sales manager of Lear Avia, last month announced the opening of new quarters in Hangar C, Roosevelt Field, Long Island, New York. Occupying two floors, the ground floor contains the sales room and the modern workshop and stockroom; the executive and secretarial offices are on the second floor.

Lear Avia state that shipments of radio apparatus to private flyers are being made with only slight delay, despite current emphasis on national defense order production. The new Roosevelt Field office is expected to greatly facilitate servicing of equipment.

Part of Lear Avia's new service station at Roosevelt Field

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

SPECIALLY ENGINEERED BRAKE LINING, CLUTCH FACINGS

The aircraft industry has friction problems peculiar to it alone—both in applying power and controlling it.

Raybestos has successfully met every one of these exacting problems put up to it. And the Raybestos Technical Department is ready to help solve more. Write us about your brake lining and clutch facing requirements or problems.

THE RAYBESTOS DIVISION of Raybestos-Manhattan, Inc. **BRIDGEPORT, CONN.**

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We are maintaining our volume production facilities and thus stand ready to meet the demands of experienced operators who need Silvaire metal trainers now and in the years ahead.

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Volume 1—Aerodynamics and Theory of Flight.
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Volume 4—Navigation and Meteorology. Radio Beam Flying.
COMPLETE GROUND SCHOOL COURSE, $3.00 PER VOLUME

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AVIATION SERVICE AND MAINTENANCE. By James G. Thompson. Price $3.00
AIRCRAFT MANUAL for INSPECTION, MAINTENANCE AND REPAIR. By Jack Linckle, Lieut., U.S.N.R. Price $3.50
METAL AIRCRAFT & DESIGN CONSTRUCTION. By Willis L. Nye. Price $3.00
NAVIGATION PACKAGE. Small tools for chart work. (Parallel rulers, protractor, dividers, scale and pencil.) Price $3.50

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LIGHT AIRCRAFT PERFORMANCE CALCULATION. By Juan Klein Serrallés. Price $2.00

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CALCULOS DE PERFORMANCE DE LAS AVIONETAS, por Juan Klein Serrallés, Ing. Ae.—Precio $2.00
EQUILIBRIO, ESTABILIDAD Y CONTROL DE LOS AEROPLANOS, por Juan Klein Serrallés, Ing. Ae.—Precio $2.00
DICCIONARIO DE AERONAUTICA, Español-Inglés e Inglés-Español, por C. T. Reid.—Precio $3.00
MANUAL DE AERODINAMICA, por Juan Serrallés, Ing. Ae.—Precio $3.00

AVIATION PRESS, 580 MARKET STREET SAN FRANCISCO, CALIFORNIA

Standing beside the REARWIN TRAINER are: Captain Maxwell Balfour, Director of Spartan School of Aeronautics, (left) and Mr. W. T. Neal, Assistant Director

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(Signed) W. T. Neal, Assistant Director,
Spartan School of Aeronautics

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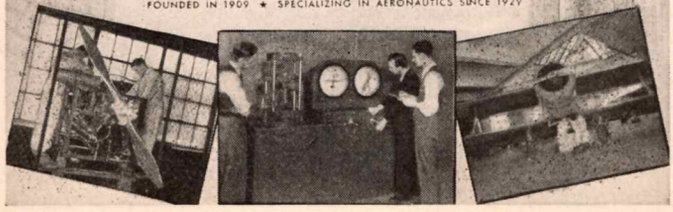
Stewart Tech Building, 253-5-7 W. 64th St., New York, N.Y.
FOUNDED IN 1909 ★ SPECIALIZING IN AERONAUTICS SINCE 1929



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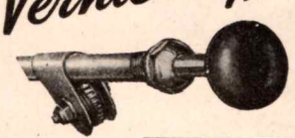
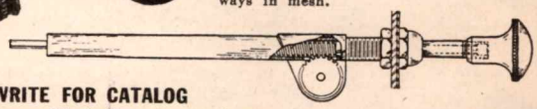
TRIMOUNT INSTRUMENT CO.
409 S. Dearborn St., Chicago, Ill.

Vernier Type
REMOTE CONTROL HEAD



Designed for double-duty, Arens' Vernier Type Remote Control Head gives coarse and micro-fine adjustments by movement of single control head. The Vernier Type Control Head cannot slip . . . it is always in mesh.



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Arens engineers will gladly assist you in any specialized remote control problem.

Where control is vital, and *necessarily remote*, use Arens Controls. They are designed and built to do the job. For over 20 years Arens has produced controls that are first by all standards.

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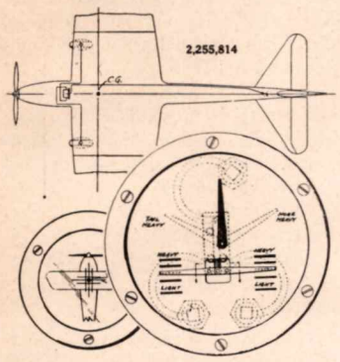
IT'S UNDER PERFECT CONTROL IF IT'S ARENS

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

TREND OF INVENTION

These patents, of interest to the aeronautical industry, were compiled from recent issues of the *Official Gazette* of the U. S. Patent Office. Copies of the individual patents, in pamphlet form, may be obtained from the Commissioner of Patents, Washington, D. C., at a cost of ten cents each.



Load distribution indicator. Jean A. Roché, Datyon, Ohio. (2,255,-814)

Flexible shaft. William P. Uhler, Tottenvile, N. Y., assignor to the S. S. White Dental Manufacturing Co. (2,255,234)

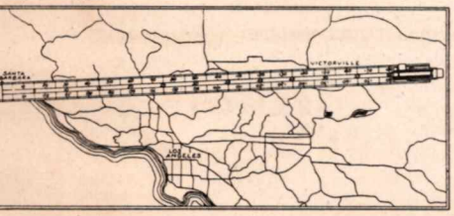
Fluid pressure operated apparatus. Ion Von Kert Hott, Dayton, Ohio, assignor to The Joyce-Cridland Company. (2,255,255)

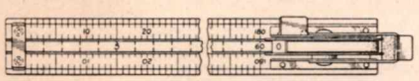
Hydraulic power system. Karl Wilfrid Fieber, Berlin-Charlottenburg, and Oskar Würthner, Berlin-Wannsee, Germany, assignors to Siemens Apparate und Maschinen-Gesellschaft mit beschränkter Haftung. (2,255,560)

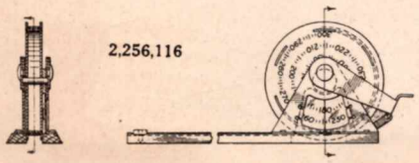
Indicating means for radio landing systems. Melville F. Peters, Beltsville, Md., assignor to Washington Institute of Technology. (2,255,569)

Winch for use on board aircraft. Charles Raymond Waseige, Rueil, France, assignor to Air Equipment. (2,255,574)

Calculating device. Howard R. Hughes, Houston, Texas, assignor to Hughes Tool Co. (2,256,116)







Engine starting mechanism (for aircraft engines). Charles Raymond Waseige, Rueil-Malmaison, France, assignor to Société Air Equipment. (2,255,575)

System for determining navigatory direction. Ernst Kramar, Berlin, Germany, assignor to C. Lorenz Aktiengesellschaft. (2,255,-741)

Flexible coupling for sound recording devices. Otto Schilling. Berlin, Germany, assignor to C. Lorenz Aktiengesellschaft. (2,255,-742)

Automatic throttle control for multiengined aircraft. Mortimer F. Bates, Brooklyn, N. Y., assignor to Sperry Gyroscope Co., Inc. (2,-255,753)

Quick release valve. William E. Huffman and George W. Replogle, Dayton, Ohio. (2,255,774)

Rotary fluid pressure device. Charles M. Kendrick, New York, N. Y., assignor to Manly Corp. (2,255,781)

Means for indicating and/or recording unknown quantities. Manfred J. Johnson, Naugatuck, Conn., assignor of one-half to The Lewis Engineering Co. (2,255,-888)

Gyroscopic compass. Elliott P. Ross, Forest Hills, N. Y., assignor to Ford Instrument Co., Inc. (2,-255,899)

Self-locking socket nut. Carl A. Swanstrom, Maplewood, N. J., assignor to Elastic Stop Nut Corp. (2,255,948)

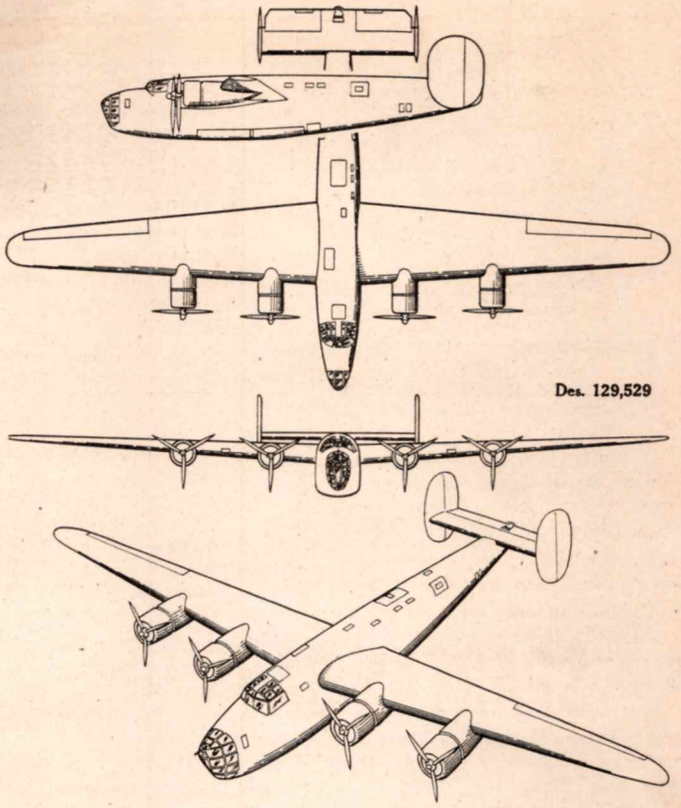
Method and means for guiding aircraft. Waldemar Ilberg and Karl Röhrich, Berlin, Germany, assignors to Telefunken Gesellschaft für Drahtlose Telegraphie m.b.H. (2,256,090)

Airplane engine. Bradford C. Lynch, Paterson, N. J. (2,256,-094)

Propeller synchronizing and other instruments. Walter P. Powers, East Orange, N. J., assignor to Associated Patentees, Inc. (2,-256,170)

Aircraft power plant (wings and fuselage that can be moulded or die cast of any suitable materials such as tenite or downmetal). Max Hahn, Seestadt Rostock, Germany, assignor to Ernst Heinkel. (2,256,-198)

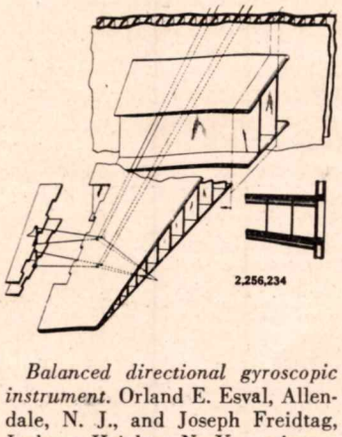
Design for a pin clip. Alfred Philippe, New York, N. Y. (129,-542)



Design for an airplane. Isaac M. Laddon, San Diego, Cal., assignor to Consolidated Aircraft Corp. (129,529)

Aircraft engine cowling. Edwyn A. Eddy, Stewart Manor, N. Y., assignor to Brewster Aeronautical Corp. (2,256,448)

Airplane wing and fuselage. Frank Ellison Best, Indianapolis, Ind. (2,256,234)



Balanced directional gyroscopic instrument. Orland E. Esval, Allendale, N. J., and Joseph Freidtag, Jackson Heights, N. Y., assignors to Sperry Gyroscope Co., Inc. (2,-256,475)

Tension wrench. James M. Hill, San Antono, Tex. (2,256,478)

Ski trimming lock (for an airplane landing gear). William Armstrong, New York, N. Y., assignor to The Dowty Corp. (2,256,540; 2,256,541 and 2,256,542)

Aviation garment (forming a parachute pack). John Raymond Cuthbert Quilter and James Gregory, Woking, England. (2,256,-597)

Aircraft and means for stabilizing the same (bladed rotor). Arthur M. Young, Paoli, Pa. (2,-256,635)

Remote control. Herman Weber, Kalamazoo, Mich., assignor to Shakespeare Products Co. (2,256,-696 and 2,256,697)

Control system. Manfred J. Johnson, Naugatuck, Conn., assignor of one-half to The Lewis Engineering Co. (2,256,760)

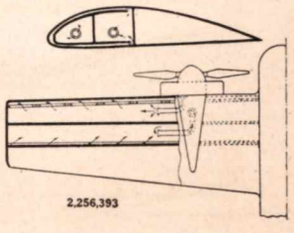
Remote positional control system. Edward F. Lazar, New York, N. Y., assignor to Sperry Gyroscope Co. (2,256,787)

Automatic steering system. Elmer J. Wade, Pittsfield, Mass., assignor to General Electric Co. (2,256,875)

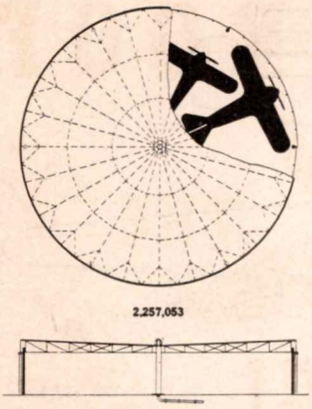
Aircraft (of the rotary wing type). Arthur M. Young, Paoli, Pa. (2,256,918)

Welding method (armor metal having a hard penetration-resisting zone). Robert K. Hopkins, New York, N. Y., assignor to M. W. Kellogg Co. (2,256,924)

Cooling the charge of internal combustion engines. Friederich Klein, Dessau, Germany, assignor to Junkers Flugzeug-und-Motorenwerke Aktiengesellschaft. (2,256,-393)



See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



2,257,053

Aircraft hangar construction. Gilbert W. Hebblewhite, Lansing, Mich., assignor to E. Clement Jarvis. (2,257,053)

Transmission (cable control) mechanism. Charles A. Arens, Chicago, Ill. (2,257,098)

Pilot's shoulder safety belt take-up reel assembly. John C. Beirise, Dayton, Ohio. (2,257,099)

Flexible device (seat and partition assembly disposed between the cockpit and the cabin of an airplane). Harry G. Brokering, Osborn, Ohio. (2,257,103)

Photograph corrector scale (measuring device for graphically determining the orthographic projection of points of known elevation perspectively represented in vertical aerial photographs). Frank Z. Pirkey, United States Army, Los Angeles, Cal. (2,257,124)

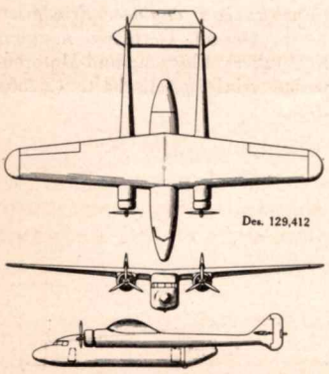
Propeller (variable pitch). Arthur G. Rindfeisch, Cincinnati, Ohio, assignor to Bocjl Corp. (2,257,126)

Airplane flush type formation light. John M. Roper, Washington, D. C., and Arnold Dircksen, Dayton, Ohio. (2,257,127)

Reclining Seat. Allen W. Clarke and Ralph F. Koeneman, St. Charles, Mo., assignors to American Car & Foundry Co., New York, N. Y. (2,257,156)

Piston. Adolph L. Nelson, Detroit, Mich, assignor to Bonn Aluminum & Brass Corp. (2,257,184)

Design for an amphibian airplane or the like. Robert J. Nebesar, Orlando, Fla. (129,412)



Des. 129,412

Air borne gyrocompass. Frederick D. Braddon, Babylon, N. Y., assignor to Sperry Gyroscope Co., Inc. (2,257,730)

Radio compass navigation apparatus. Francis L. Moseley, Yonkers, N. Y., assignor to Sperry Gyroscope Co., Inc. (2,257,757)

Distributor. Jakob Bohli, Solothurn, Switzerland, assignor to Bendix Aviation Corp. (2,257,781)

Joint (comprising opposing flat plates and a member of rubber-like material bridging the space between). Hugh C. Lord, Erie, Pa., assignor to Lord Manufacturing Co. (2,257,804)

Rotor (magnetic). Tullio Tognola, Sidney, N. Y., assignor to Bendix Aviation Corp. (2,257,824)

Frequency-modulated radio altimeter. Irving Wolff, Merchantville, and Royden C. Sanders, Jr., Audubon, N. J., assignors to Radio Corp. of America. (2,257,830)

Electric welding machine (for welding tubes). John F. Windsor, Chicago, and Clayton Mark, Jr., Evanston, Ill., assignors, by mesne assignments, to The Youngstown Sheet and Tube Co. (2,257,875)

Cleaning aluminum surfaces (composition particularly adapted for removing aluminum oxide, etc., from aluminum surfaces). William M. Humphrey, Jackson Heights, and Robert E. Lee, Jamaica, N. Y. (2,257,960)

Process of producing (calcium) aluminum alloys. Robert Suchy and Hellmuth Seliger, Bitterfeld, Germany, assignors, by mesne assignments, to Walther H. Duisberg. (2,257,988)

Direction finding system. Hans Eggers, Berlin, Germany, assignor to C. Lorenz Aktiengesellschaft. (2,258,006)

High altitude chamber. Jay A. Heidbrink, Minneapolis, Minn., assignor, by mesne assignments, to Air Reduction Co., Inc. (2,258,054)

System for conditioning air for engines. William E. Dunn, Kansas City, Mo., assignor to The Fluor Corporation, Ltd. (2,258,088)

Variable pitch-propeller. Curt Keller, Zurich, Switzerland, assignor to Escher Wyss Maschinenfabrieken Aktiengesellschaft. (2,258,094)

Aircraft wing structure. Virginius E. Clark, Hagerstown, Md., assignor, by mesne assignments, to John F. Neary, Jr. (2,258,134)

Engine starter gearing and *Internal combustion engine.* Romeo M. Nardone, East Orange, N. J., assignor to Bendix Aviation Corp. (2,258,159 & 2,258,160)

Adjustable dial test indicator mounting. James O. Coleman, Los Angeles, Calif., assignor to The L. S. Starrett Co. (2,258,175)

Nut lock. Fred Hinds, San Bernardino, Calif., assignor of forty-nine percent to Henry De Armond and E. W. Martin. (2,258,181)

Ice-inhibiting composition (comprising a true solution consisting of a mixture of 20 to 60 parts ethylene glycol, 8 to 10 parts glycerol, and 2 to 5 parts formaldehyde). Francis P. Keenoy, Kansas City, Mo., assignor to Henry T. Nolan. (2,258,184)

Method of magnetic testing. Carl E. Betz, Park Ridge, Ill., assignor to Magnaflux Corp. (2,258,274)

Apparatus for measuring the elastic properties of materials. Jacob R. Boettler, Chatham, N. J., and Walter W. Werring, Brooklyn, N. Y., assignors to Bell Telephone Laboratories, Inc. (2,258,276)

Aerial torpedo (mechanism for launching aerial torpedoes from an airplane). Leonid A. Dunajeff, New York, N. Y., assignor to Commercial Ingredients Corp. (2,258,281)

Power transmission (system for driving a load device from either of two power sources). Harry F. Vickers, Detroit, Mich., assignor to Vickers, Inc. (2,258,307)

Automatic fuel shutoff for vehicles. James E. Gray, Charlestown, Mass. (2,258,323)

Engine starter gearing. Burr W. Jones, Elmira Heights, N. Y., assignor to Bendix Aviation Corp. (2,258,455)

Electric synchronizer (for synchronizing the speeds of cooperating power-plants). Erle Martin, West Hartford, Conn., assignor to United Aircraft Corp. (2,258,462)

Desludging device. Veon I. Moncrieff, West Hartford, Conn., assignor to United Aircraft Corp. (2,258,463)

Airplane wing. Jack Gutridge, Chicago, Ill. (2,258,490)

Pipe Union. Paul Wurzburger, Paris, France, assignor to Patex Société Anonyme. (2,258,528)

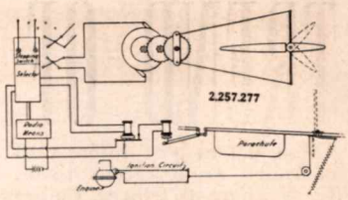
Welded structural member (method of making a beam). Gerald G. Greulich, Mount Lebanon, Pa. (Reissue 21,921)

Electromagnetically operated petrol supply pump. Karl Glässing, Stuttgart, Germany, assignor to Robert Bosch Gesellschaft mit beschränkter Haftung. (2,258,586)

Gas valve for liquid heaters (adapted to be controlled by a liquid-deficiency device). Otto Merten, Dessau, Anhalt, Germany, assignor to Junkers & Co. G.m.b.H. (2,258,590)

Internal combustion engine (having cylinders arranged in star shape). Rudolf Hasenzahl, Dessau, Germany, assignor to Gotthard Sachsenberg Zentralgesellschaft mit beschränkter Haftung. (2,258,649)

Adjusting device for fuel injection pumps. Heinz Links, Gaggenau, Germany, assignor to Daimler-Benz Aktiengesellschaft. (2,258,655)



2,257,277

Radio controlled recovery means for aircraft. Walter H. Righter and Kenneth Wallace Case, Glendale, Cal., assignors to Radioplane Company. (2,257,277)

Airfoil. Alexander Kartvelichvili, North Hempstead, N. Y., now by judicial change of name Alexander Kartveli, assignor to Seversky Aircraft Corp. (2,257,260)

Tension gauge. Jean A. Roche, Dayton, Ohio (2,257,483)

Fastening device. Victor F. Zahodiakin, Maplewood, N. J. (2,258,668)

Fixation of window panes in aircraft (window mounting comprising a concave-convex pane adapted to withstand the stresses exerted by the difference in air pressure inside and outside an airplane cabin at high altitudes). Herbert Wagner, Berlin-Schmargendorf, and Justus Muttray and Ludwig Wagenseil, Dessau, Germany, assignors to Junkers Flugzeug-und-Motorenwerke Aktiengesellschaft. (2,258,724)

Parachute. John Overbeke, Cleveland Heights, Ohio. (2,258,797)

Thermocouple. Hector Rabezzana, Flint, Mich., assignor to General Motors Corp. (2,258,809)

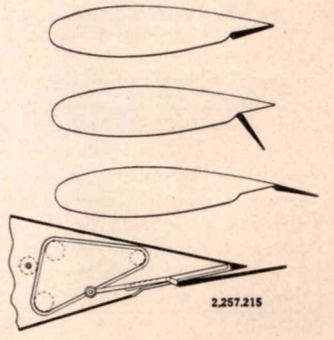
Shielded aircraft spark plug. Hector Rabezzana and Alexander J. Battey, Flint, Mich., assignors to General Motors Corp. (2,258,810)

Riveting clamp (adaptable to be inserted through an opening). Joseph Thomas Sturgiss and Henry Singer, Honolulu, Territory of Hawaii. (2,258,822)

Instrument for use in flying aircraft (altimeter). Eilet M. Torkelson, Elizabeth, N. J., assignor to Bendix Aviation Corp. (2,258,826)

Clip nut. James P. Burke, Knoxville, Tenn., assignor to Bert L. Quarnstrom and F. L. McLaughlin. (2,258,845)

Split flap. Edward F. Zap, West Chester, Pa. (2,257,215)



2,257,215

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

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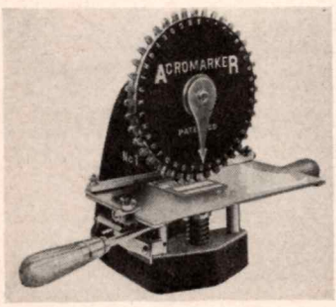

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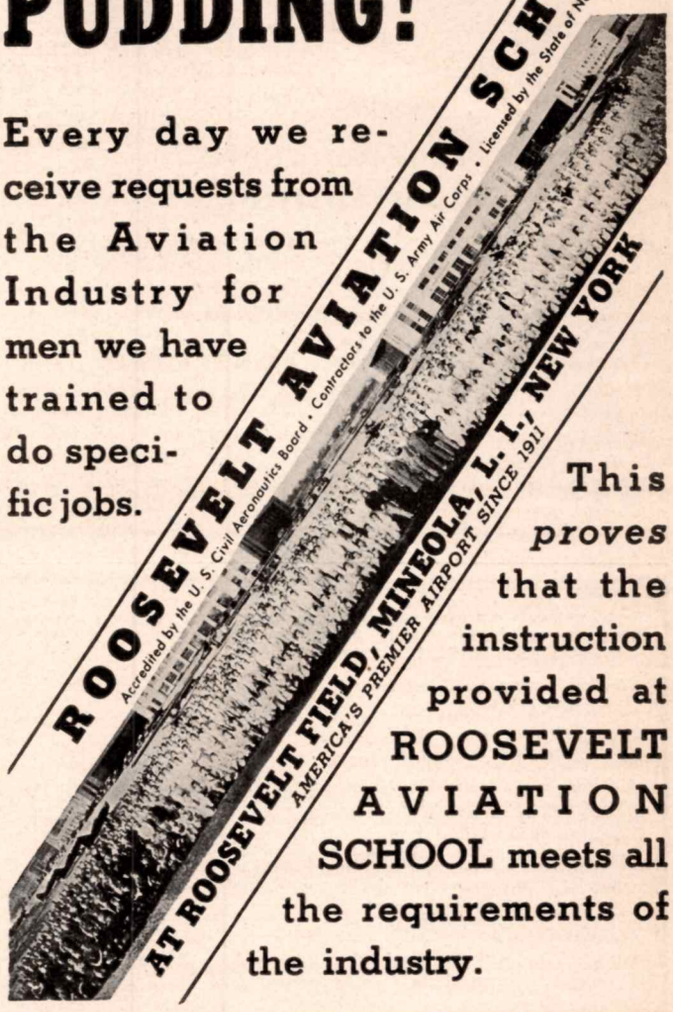
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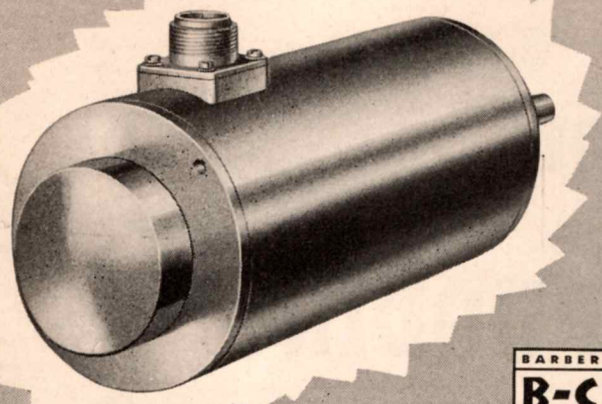

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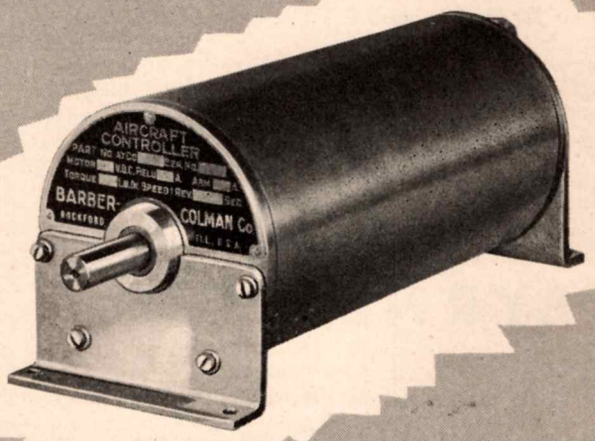

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STATEMENT OF OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

of AERO DIGEST, published monthly at New York, N. Y., for October 1, 1941.

State of New York, } ss.:
County of New York, }

Before me, a Notary Public in and for the State and County aforesaid personally appeared Frank A. Tichenor, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the AERO DIGEST, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Aeronautical Digest Publishing Corp., 515 Madison Avenue, New York, N. Y.; Editor, George F. McLaughlin, 515 Madison Avenue, New York, N. Y.; Managing Editor, None; Business Manager, Frank A. Tichenor, 515 Madison Avenue, New York, N. Y.

2. That the owners are: The Aeronautical Digest Publishing Corp., 515 Madison Avenue, New York, N. Y.; Frank A. Tichenor, 515 Madison Avenue, New York, N. Y.; Jessie H. Tichenor, 515 Madison Avenue, New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) FRANK A. TICHENOR.

Sworn to and subscribed before me this 26th day of September, 1941.

(Signed) Elizabeth M. Davenport, Notary Public,
New York County Clerk's No. 32.
(My commission expires March 30, 1942.)

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ARTICLES IN FOREIGN TECHNICAL MAGAZINES

Structures

Variable Distributed Loads in the Theorem of Three Moments. F. J. Turton. The Journal of The Royal Aeronautical Society. No. 366; June, 1941

The three moment equation used in the calculation of continuous beams is an everyday tool of a stress engineer. It is generally applied in its more familiar form based on the assumption of uniformly distributed loads and constant moments of inertia. Text books provide for unexpected complications and indicate good practical grapho-analytical methods for treating more unorthodox loadings and structures. Turton, skillful in mathematical symbolism, shows an analytical method for solving the problem of a continuous beam of arbitrary cross sections and loadings. Although it is not thought that the paper has practical merit, it is reported here for its academic interest.

Engines

A German View on Allied Engines. An Enemy Report on Five English, Three French and Two American Types Captured. P. Kötzschke. Aircraft Engineering. No. 151; Sept. 1941

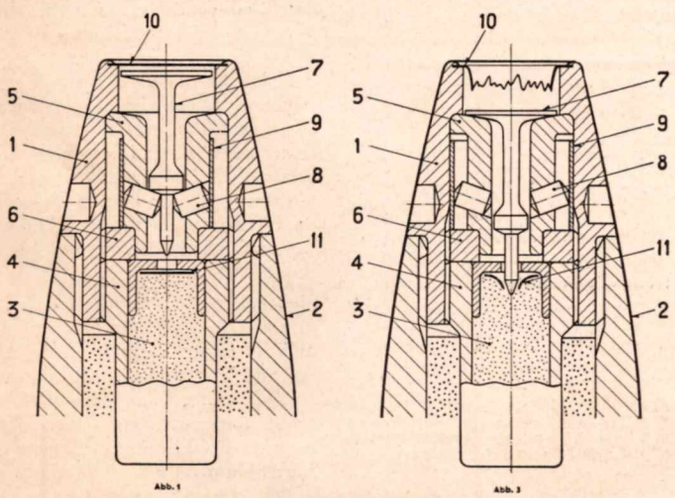
A similar paper by E. Michaelis, *Die Flugmotoren des Feindlichen Auslandes,* which appeared in *Luftwissen* in 1940, was reported here at the time. The present article represents a translation of a lecture delivered to the Lilienthal Society of Aeronautical Research. The engines which form the subject of the paper are Rolls Royce *Merlin X* and *II, Hispano-Suiza* 12 Ycrs, Bristol *Hercules II* and *Mercury VIII,* Gnome-Rhône 14 N2/3 and 14M6, Pratt & Whitney *Twin Wasp* SC 3G, Armstrong *Tiger VIII,* and Wright *Cyclone* GR-1820 GW-2A. The investigation includes metallurgy and technology in connection with these engines, no mention being made of the operational characteristics. The author emphasizes the greater amount of chrome and nickel used in highly stressed parts than in German materials employed for a similar service.

Propellers

The Propeller. How Many Blades? F. W. Lanchester. The Journal of The Royal Aernonautical Society. No. 368; Aug., 1941

As Dr. Lanchester points out, "Propeller theory has always been a subject of extreme difficulty, and those who originated the screw propeller as means of propulsion and developed it during the latter half of last century were in most part guided by common sense and empiricism." Since those days the propeller theory has been further complicated by attempts to take in more of the physical phenomena which bear on its functioning. In this connection the increase in power and speed has emphasized the importance of the blade number whose proper selection can be made by the aid of suitable charts and calculations.

Dr. Lanchester brings out a fresh approach to this problem, based on intuitive understanding of the underlying physical phenomenon of propeller operation. Although probably lacking in apparent mathematical rigor, the interpretation is so clear and tangible a reading should be of great value both to a skilled mathematician and a young student as an aid to a "common sense" approach to this difficult question.



Oerlikon projectile before impact and at the instant of impact

Vibrations

Note on Biot's Dynamic Modulus. W. J. Duncan. The Journal of The Royal Aeronautical Society; No. 366; June, 1941

Biot's dynamic modulus is defined to be the ratio of the amplitude of the applied periodic couple to the amplitude of the angular movement produced at the point of application, and is a function of the frequency of the periodic couple.

Thus, since the natural frequencies of the system can be found when the dynamic moduli of the components as functions of frequency are known, the conception of the dynamic modulus is useful in the treatment of the engine-propeller system. In the present note a general investigation of the dynamic modulus of undamped systems is given, and simple general formulas are derived.

Linear Equations

Solution of the Simultaneous Equations Resulting from Successive Applications of the Theorem of Three Moments to Continuous Beams. F. J. Turton. The Journal of the Royal Aeronautical Society; No. 368; Aug. 1941

It is commendable that Turton after presenting an involved analytical solution of a continuous beam in a previous article now offers this contribution to aid in the laborious calculations involved in the solution of simultaneous equations associated with the problem. The method is an iterations process but the recognition of its value in this case is a contribution as a labor saving device in everyday stress work.

Arms

The Explosive-Incendiary Projectile of the 20 mm Oerlikon Cannon. (Der Schrägbolzen-Aufschlagzünder der 20 mm-"Oerlikon"-Granaten. Flugwehr und Technik; No. 7; July 1941)

Brief description of the special aircraft projectile used in the Oerlikon cannon giving method of operation, materials of construction and detail design. *(See accompanying illustration.)*

Signal Lights

Control of the Temperature of Color of Incandescent Signal Lamps (Contrôle de la Temperature de Couleur de Lampes a Incandescence Destinée a des Feux de Signalisation. M. Roulleau. Publications Scientifiques et Techniques du Secrétariat d'État a l'Aviation; B.S. T.N. 92; 1941)

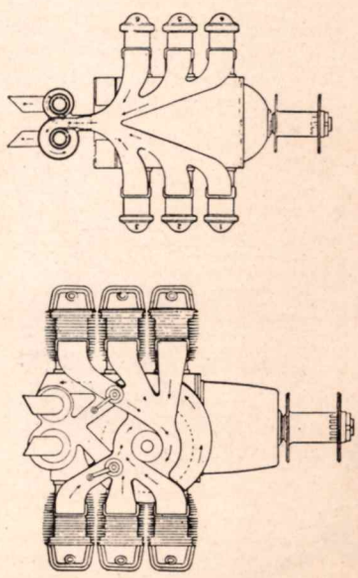
It is pointed out that the use of a filter does not assure proper color source of a signal or position light nor make certain perfect recognition of the specified color.

According to the author the double necessity of assuring proper signal intensity and consistent color consistency makes it necessary to employ temperature control of the color. The paper describes special apparatus devised by the author for practical use of the principle involved and also gives the experimental and general background which indicates the need for the proposed control. The apparatus proposed is appropriately called the chromopyrometer.

Engines

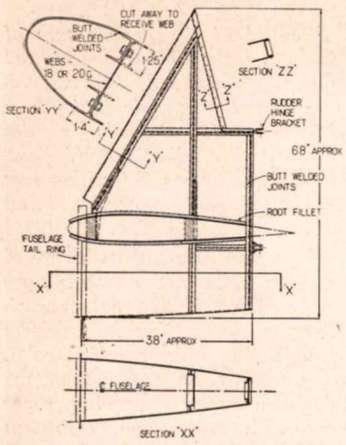
Two-Cycle Aircraft Engines (Tvataktsmotorn som Flugmotor. T. Edlen, Flgnng; No. 13B; July, 1941)

Advantages of two-cycle operation are well recognized by engine designers but the practical problems of design have, so far, prevented the realization of the theoretical superiority of this type over the standard four-cycle type. One of the most important problems concerns the scavenging of the cylinder after the explosion has been completed. The article reviews various phases in connection with the two-cycle aircraft engine design and, in some instances, offers novel solutions to overcome these. *(See accompanying illustration.)*



Two-cycle aircraft engine designs

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue



Design of a fin constructed of Elektron

Design

New Uses of Electron Sheet. Methods of Overcoming Difficulties of Manipulation. D. B. Winter. Aircraft Production; Vol. III, No. 31; May, 1941

The heavy demand of aircraft quantity production has been reflected in shortages of various materials, not due to basic lack of materials but rather in long delivery dates. It is therefore logical to seek at this time greater diversification of materials for aircraft by introducing both lighter as well as heavier density alloys provided they are suitable for aircraft application.

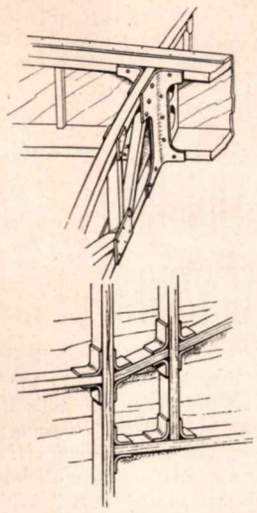
Unfortunately, however, long familiarization with aluminum alloys prompts the application of well established methods of design and production to these new materials without regard to their individual characteristics. In this article the author points out special requirements which should govern the design and production of parts intended to be manufactured of magnesium alloy known by the trade name of Electron. *(See accompanying illustration.)*

Castings

Foundry in Aircraft Construction. (La Fonderie dans la Construction Aëronautique. R. De Fleury. Publications Scientifiques et Techniques du Secrétariat d'État a l'Aviation; B.S. T.N. 93; 1941)

At one time few men in aircraft would have been interested in the subject of castings and foundry practices. Today, however, a number of our production engineers, as well as new foundries personnel called suddenly to produce aircraft castings could be expected to be interested in this matter.

As the paper points out, the increase in quantities of parts suitable to be designed as castings must be produced in quantities much larger than heretofore. While small production of good



Two examples of the use of plywood gussets in the Airspeed Oxford—joint between a rib and tailplane main spar and a section of the internal spruce ribbing of the fuselage skin

light aircraft castings may have been mastered by a few concerns the larger quantities and inexperience of new concerns have opened up numerous problems in connection with obtaining consistently good qualities. The author analyzes various phases of casting technique, metallurgy and foundry practices in the endeavor to point out the important factors to be considered in producing quantities of aircraft castings.

Fuel Dumping

Performance of a Jettison System. An Investigation of the Hydraulic Performance, in which the Importance of Adequate Venting is Stressed. M. J. Brennan. Aircraft Engineering; No. 151; Sept., 1941

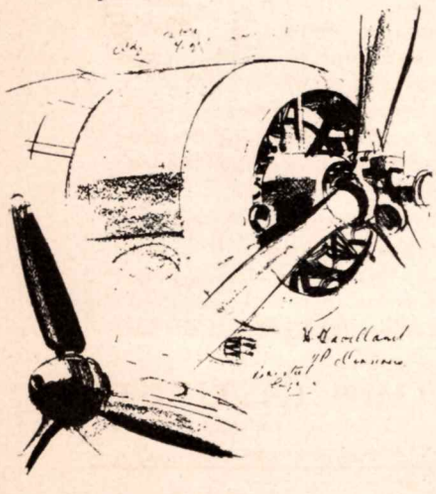
Fuel dumping methods have been of particular importance in long range aircraft but it appears that this problem has been receiving recent attention in connection with naval aircraft. The article mentions the fact that the British Fleet Air Arm requires the evacuation of fuel from the tanks before stowage of airplanes below deck.

Two main aspects of the problem of the design of a jettison system include: (a) the hydraulic performance of the system which entails the design of the pipe and valve arrangement such that a given quantity of fuel will be jettisoned in a given time, the available head being known; and (b) the consequent physical complications of jettisoning this fuel, of which the main problems are the electrostatic charging of the aircraft, due to fuel flow and evacuation, and the subsequent possibility of electrostatic discharge and explosion. There is also the possibility of the re-entrance of the fumes of the jettisoned fuel into the compartments of the aircraft.

REVIEWS OF BOOKS

HOW TO DRAW PLANES. Frank A. A. Wootton. Published by The Studio Publications, Inc., 381 Fourth Ave., New York. 64 pg., illustrated. $1.

Anybody who likes to draw, and especially engineers who are more likely to put their ideas on paper in the form of drawings, will find this little book helpful, even if they are quite adept with the pencil.



Wootton has done some remarkable work, both with the brush and the crayon. His efforts have been consistently accurate, technically, so in writing about his subject he speaks with justified authority.

Your reviewer found most interesting this little book full of helpful hints on how to make better drawings of airplanes, and feels sure that those who take the trouble to get a copy of it will also discover that they too can do better with their drawings. The presentation is quite simple and covers thoroughly the various phases of doing a commendable drawing job.

•

AIR TRANSPORTATION. Claude E. Puffer. Published by The Blakiston Co., 1012 Walnut St., Philadelphia, Pa. 675 pgs., numerous diagrams. $3.75.

Every once in a while there appears a book which merits praise of the highest order because it meets a real need. We put Puffer's work in this category, for it's been a long time since we've had the pleasure to review a book which so aptly covers its topic.

An important contribution to the fast growing field of air transportation, the book is an important reference to the activities and decisions of the CAB and its predecessor agencies. It gives all the details and covers also the decisions of the ICC in air mail cases from 1935 to 1938.

Covered also are the economic and legal characteristics of the air transport industry, the activities and powers of other government agencies which affect the industry. It contains an analysis of the economic principles applicable to the regulation of discriminatory rates, presenting simply the theory of price discrimination.

While *Air Transportation* is intended primarily for students of transportation, public utilities, public administration and economic theory, it also will be of tremendous instructional value to all those interested in the increasingly important air transport industry.

•

STANDARD AIRCRAFT WORKERS MANUAL. (Revised edition.) Stuart Leavell. Published by Fletcher Aircraft Schools, 625 N. San Fernando Rd., Burbank, Calif. $1.50.

A useful reference for trainees and workers in airplane manufacturing, maintenance and repair occupations, this book contains illustrations and descriptions of materials and tools and their uses; information on A, An and B standard parts; riveting; assembly and installation procedures and practices; shop geometry and blue print notes. Included are a glossary of aeronautical terms, tables, charts, formulæ and miscellaneous information. Blank pages are included for notes.

Each of the eight sections has been revised and brought up to date and contains twice the content material as previous editions.

The new pocket edition is a complete handbook of aircraft construction which has been developed over the past 6 years as a reference book. It is complete and accurate and serves as a dependable source of information and data on aircraft construction from the workers' standpoint.

The contents include these eight divisions: fundamentals of aircraft construction; aluminum and its alloys, aircraft steel; AC, An and B Standard parts; assembly, riveting and installation; tools, their care and use; shop geometry, sketching, dimensioning; blue print notes and glossary; tables, charts, formulas, miscellaneous.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

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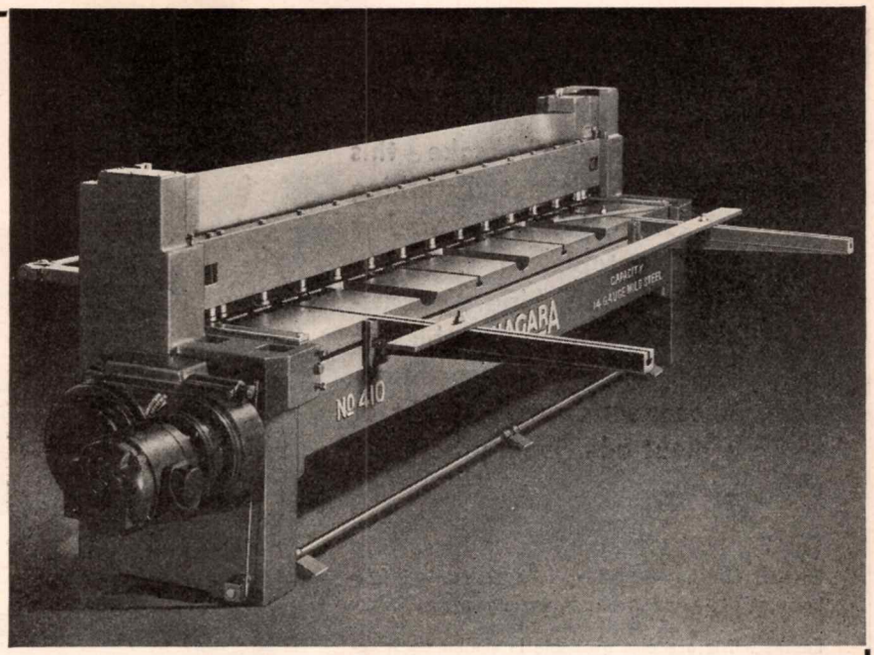

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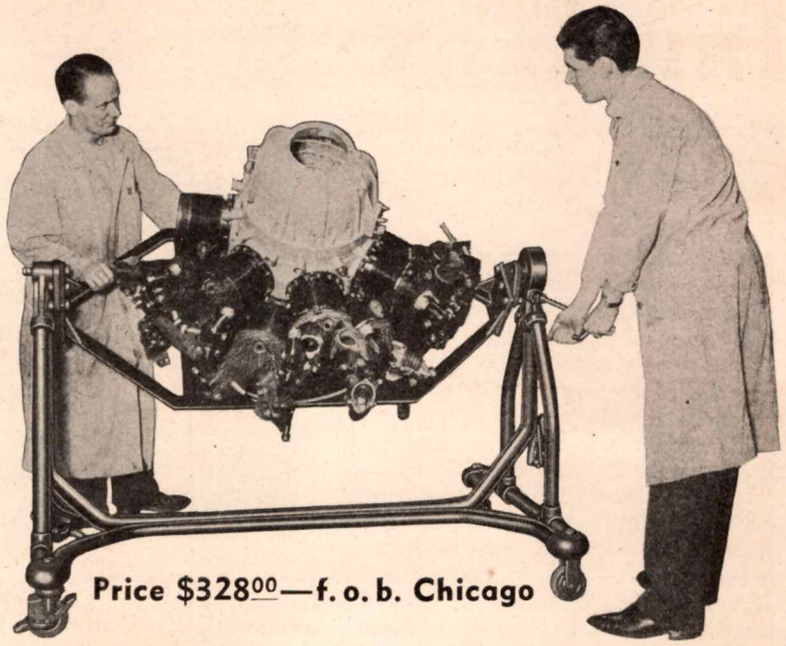

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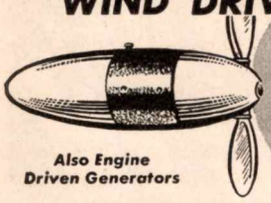

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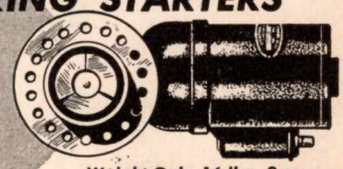

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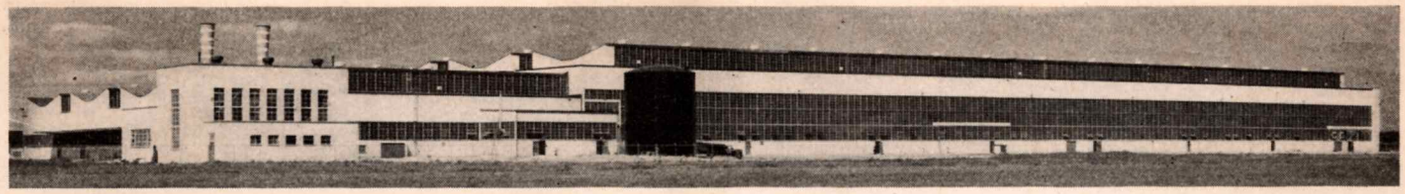
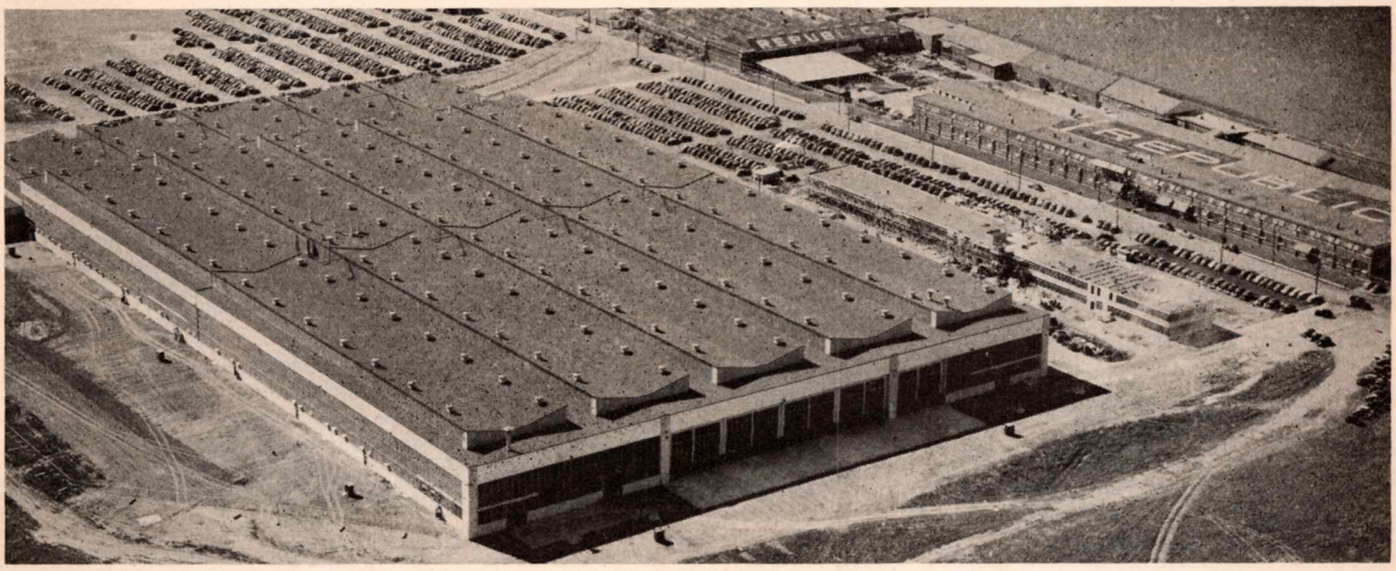
SEE PAGE 68 OF THIS ISSUE FOR TWO IMPORTANT ANNOUNCEMENTS



Two views of the new Republic Aviation assembly building at Farmingdale, N. Y. In the view below can also be seen the new $300,000 administration building which adjoins the assembly building



FACTORY EXPANSIONS

(Continued from page 64)

concrete paving in the roadways at each site. Over and above the 27,000 tons of structural steel there will be approximately 4460 tons of sheet steel in the sidewalls and roof, 1000 tons in the doors, and about 750,000 sq ft of exposed steel in the sidewalls at each plant.

Republic Aviation

From the loading platform at the western end of the giant building to the hangar doors at the eastern end, the new Farmingdale, N. Y., plant of Republic Aviation Corp., is designed for the most efficient type of line production of Republic high-altitude interceptors.

At the railroad platform, an 8-car train can discharge the thousand items of material parts, supplies and sub-contracted assemblies which are required for the manufacture of the modern military airplane. From the platform, this conglomerate mass of material goes directly into storerooms lining the eastern wall and is held there awaiting its time to enter the flow of production.

At the opposite end of the building, 800 ft. away, four assembly lines will send their finished planes out to one of the mile-long runways of the greatly-enlarged, 240-acre Republic flying field.

Modern pursuit aircraft are steadily growing larger, but they still are the smallest type of combat plane. Therefore, a building primarily designed for pursuit or interceptor production is not likely to require the vast areas of a bomber or engine plant, even though large scale production is contemplated.

Nevertheless, coming to 500,000 sq ft the new Republic plant is big. It cost more than $3,000,000 to erect, the work being done by the Turner Construction Co., from plans by Albert Kahn Associated Architects & Engineers, Inc.

Equipment for the building, including a substantial press department, three paint shops, an inspection laboratory and one of the most advanced material handling setups in the industry, added another $3,000,000 to the cost. All of this was financed by Republic Aviation under a Government facilities agreement, calling for repayment of the total amount by the Government, payments to be extended over a five-year period.

Adjoining the assembly building and lying between it and the older Republic Aviation plant is a new $300,000 office building which houses all administrative activities.

With the older units (15 separate buildings) scheduled to maintain their usefulness as machine shop units, warehouses, tool and jig shops, experimental and engineering production shops, and for special purposes such as lofting and similar work, the new building will incorporate all of the actual manufacturing operations flowing to the assembly lines of the P-43 *Lancer* and P-47 *Thunderbolt*, the two types now in production for Air Force high-altitude combat work.

The entire building is a single open unit, except for the paint shops, the inspection unit and the personnel department offices and hospital which are located in the building for greater convenience and service. No columns or partitions complicate the material flow and Republic's production men will be able to rearrange departments or re-route movement of materials and parts at will, to meet any future requirements or flow production problems with extension to the east the first which would be undertaken when necessary.

This principle of free and open traffic for manufacturing operations is altered at only one point, by the introduction of a purposeful, carefully-arranged "bottleneck" half-way down the building.

Here, the inspection laboratory juts out into the building from one wall, while the large parts paint shop juts out from the opposite side. These two practically meet, forming a barrier across the building that is broken only by an aisle 15 ft wide, connecting the subassembly and detail departments to the west with the final assembly floor to the east.

Here, the inspection department checks every part before it goes to final assembly so that in effect thes arrangement is assurance that nothing will be able to get into a finished airplane which has not received inspection. No assembly, part or item will pass through the corridor "bottleneck" without inspection's permission.

The final assembly lines make extensive use of monorails, electrical and me-

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

chanical hoists and similar devices for expediting the movement of units through the factory.

The main portion of the new building, which is arranged generally for assembly purposes, has a clear height of 35 ft. This main working floor consists of three areas, the center one 800 ft long by 200 ft wide and the two side areas each 800 ft long by 150 ft wide; all of these areas are entirely free of columns or other structural members.

The western end of the building, consisting of five 100-ft-wide bays, has a clear story height of 20 ft, and is being used for tool shops and stock rooms. In this section 50,000 sq ft of basement area is provided for locker rooms, toilets and fan room and a flat slab designed to support heavy machinery spans over the basement. Four other wash rooms and toilet rooms are located throughout the building basement.

At the east end a 200-ft-wide canopy door, 35 ft high, has been provided to enable the largest planes to leave the assembly lines and roll to the nearby hangar.

Hundreds of thousands of dollars' worth of new machinery and equipment have been installed, the full inventory covering such items as a 4500-ton hydraulic press, several other large presses of heavy capacity, batteries of punch presses, a large spot-welding division, a most modern automatic and hand painting equipment installation and numerous special tracks, overhead trolleys and monorail installations for expeditious handling of assemblies and parts.

Special thought and study centered on the electrical design has produced one of the industry's most modern lighting installations. The entire plant is lighted with 42 continuous rows of fluorescent fixtures 500 ft in length, spaced 22 ft apart. In case of power failure, there is an emergency system to serve the vital equipment in the plant until normal power is restored.

Ventilation is achieved by a series of exhaust and supply fans through the roof, designed to change the air completely about six times an hour. The same system is available for comfort ventilation in the summer, and the connections of all units are flexible to permit any combination for operation to meet existing conditions.

In addition, a separate supply and exhaust system is installed for the hospital with individual exhaust systems provided for personnel offices, inspection control laboratory, process room and all paint shops.

The factory is completely sprinklered. To maintain a proper reservoir of water, a 250,000-gal storage tank and two fire pumps each having a capacity of 1000 gpm at 100 lb pressure have been provided.

The exterior features the use of buff-colored, smooth-faced Speed Wall tile to a height of 7 ft above the floor. The entire building is so constructed that any extensions or improvements may be added without seriously interfering with production.

ARC WELDING TECHNIQUE

(Continued from page 133)

to be removed by grinding. Then a new weld can be made and finished off at the end of the ground-out area without leaving an undesirable crater and without appreciably changing the even contour of the weld deposit. When these procedures are skillfully followed, the arc weld deposits made under any of the above conditions are free from porosity or spatter, well penetrated and smooth and even in contour.

Training Operators

Since the successful application of this method is subject to the personal control of the welding operator while he is actually depositing metal, the quality of the finished work is naturally largely dependent on the welding personnel. This indicates the necessity for a consistent training program. North American Aviation officials have been able to build up a highly efficient and satisfactory welding department by a policy of cooperation with local vocational schools. By conference with local school directors and teachers they have detailed their requirements and have furnished to the teaching staffs a considerable degree of guidance in training methods which would develop the desired skills for their work. In some cases they have assisted the welding schools in selecting and obtaining the equipment and materials which would make the training conditions closely approximate conditions in the plant.

Students for the aircraft arc welding courses are carefully selected for aptitude and attitude. Their progress is checked at intervals during the training period, and before being given encouragement to apply for employment, they are required to pass the conventional qualification tests at the school. When they apply for employment, they are, according to existing regulations, required to pass a final qualification test.

It has often been found in the welding industry that plant qualification tests are regarded as a necessary evil and all too often are conducted in such a hurried or impersonal manner as to be discouraging to the inexperienced student. North American Aviation officials do not take chances of missing good operators who have a desirable amount of inherent skill but who may do considerably less than their best because of the nervous strain of the qualification procedure. On the contrary, applicants are put in the charge of expert welders and are given an opportunity to watch the normal operations of the welding department and to weld with the plant equipment under the supervision and guidance of experienced men until they show that they feel thoroughly at home and relaxed. Under these conditions, the applicants will show their real ability and aptitude.

Sufficient experience has been gained with this training program to indicate that the theory behind it is sound and workable. To a considerable degree it is a specialized program because in addition to the normal amount of manipulative skill required to deposit a satisfactory weld on extremely thin material and around a large variety of contours, there is the necessity to develop skill in tapering off the melting rate at the critical time when the arc is about to be broken. During their training period, students are encouraged to use the *Stroco* to study the effect of various adjustments of the control button and to practice reducing the current at different rates. These studies are sometimes made independently and sometimes in connection with a prescribed welding exercise. It is impressed upon the students that the *Stroco* crater eliminator is not a device which will relieve them of the responsibility of being careful, but it is rather an accessory which is always available for use when certain welding conditions are encountered. During the time the student is becoming prepared for the plant qualification test, he is given an opportunity to observe the great variety of these conditions which exist and which are handled as a routine matter, and he soon realizes that the conditions for crater forming are frequent and constant in the actual production. This encourages him to give even more serious attention to the manipulation of the control, and after he passes his qualification test he gives maximum attention to this feature of the welding technique right from the start.

Conclusion

The problem of developing satisfactory arc welding procedures may be said to have found solution in North American Aviation's plant by a combination of several factors, all of which have a vital bearing on the success of the production program. The plan which is followed for checking each piece of tubing before putting it in stock keeps assembly operations moving steadily, thus multiplying the production rate. The use of the *Stroco* crater eliminator and the development of the proper technique for its application have removed an important source of defective welding. Close cooperation between the plant administration and local training facilities has provided a satisfactory source of supply of welding personnel whose training from the beginning has been definitely adapted to plant requirements and plant working conditions.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

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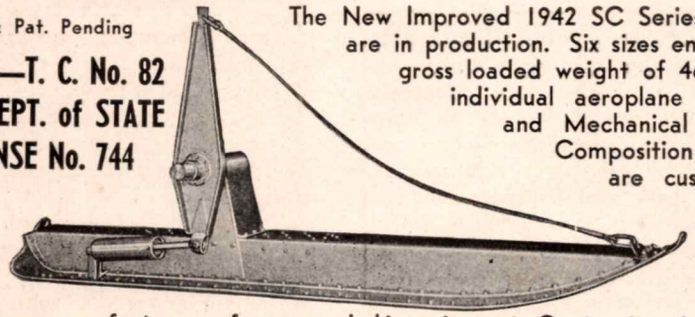

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TRUTH ABOUT STRIKES

(Continued from page 51)

someone he has appointed to take over, will continue to win them.

The sources of Mr. Roosevelt's political power are as obvious as the reasons why he won the last election. He realized that in order to stay In he needed votes. He went out and got them in the only way that votes ever have been got in this country. Initially, while Hoover and his gang were the Ins, Roosevelt promised to Do More for those who had least and Wanted More. When he got In, he proceeded on the sound assumption that the way to hold the votes of those who had Nothing was to take something from those who had Something and give it to those who had Nothing—and probably deserved it.

He was not unobservant of the fact that there were more voters with nothing, or next to nothing, than there were voters with something. So his philosophy of government has been to pass laws favoring the Have Nots at the expense of the Haves. This is a popular policy; and it will continue to work until the Haves in time become Have Nots.

Social Legislation Platform

The long line of so-called "Social" legislation that has served to fix the New Deal permanently in the saddle was all, without exception, based on the idea of collecting votes, by showing the Little Man, and even the Midget, that he was going to get something out of the Big Fellows. The farmers early felt the warm Rooseveltian handclasp of Economic Brotherhood. That comrade on the farms had been working too hard, and getting too little for it. Roosevelt, with the AAA, ordered him to lean back, do less, and get more for what he did. The Farmer sighed gratefully, and has voted the straight New Deal ticket ever since.

There was unemployment. There was always unemployment, but in 1932 there was more than usual. It became a Sacred Cause. Unemployment became a devil to be exorcised by the New Deal priests who went forth bearing banners with strange devices, WPA, Home Relief, PWA, CCC, NYA. The unemployed sat down, like the children of Israel, and manna descended upon them. They've been sitting down ever since; the long sitters have no intention of ever getting up. If Roosevelt forces them to get up, he'll lose votes; and he has no intention of doing that.

Organized labor is also an organized voting group. It would vote the way its leaders told it to vote. Roose-

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

velt sensed that, and so did Senator Wagner, an In. Early in the game the labor vote was cinched by the Wagner Act, the most vicious act regulating labor disputes. That act made no pretense of being fair. It was a one-sided act to coddle labor and to belabor the employer. It describes "unfair practices;" but these are unfair only if performed by the employer; the labor union can get away with anything. A labor union may encourage or coerce membership in a union; an employer may neither encourage nor discourage membership in a union, even by telling the plain truth about a union.

There is no provision that a union must come into court with clean hands. A racketeer-dominated union can make use of the courts to further its own ends. It may call upon the Federal complaint and election machinery of the Labor Board; the employer is bound by the result of the election, the union is not. The employer cannot break an agreement with a union without incurring penalties; the union may and frequently does break its agreements, and incurs no penalty whatever. Recent Supreme Court decisions have held that unions are exempt from anti-trust laws unless they conspire with non-labor groups to violate them. That is, if they conspire with an employer to violate anti-trust laws, they are liable; but they are free to violate those same laws so long as no employer is aiding and abetting them. That is as reasonable as saying that a union man may with impunity commit murder, but if someone owning a factory helps him, then in that case he may be apprehended for murder. It was Mr. Dooley who said, "As goes the election, so goes the Supreme Court."

Unions Get Free Rein

Under Supreme Court decisions, a union evidently has the legal right to boycott and ruin an employer if he deals with another union certified by the Labor Board. Unions have the legal right to conspire to keep more efficient methods of production out of a State. The nation wants to erect several hundred pre-fabricated houses to house workers in defense industry. The Union won't let it do so; union members wouldn't make as much money erecting those houses. Let the taxpayers pay more for less modern houses. To hell with the average citizen! He's not an organized voter, and has no legal right to protection of his tax-money. The union man is organized, and he'll vote the way he's told by his bosses. The taxpayer will only kick and soon forget it; the union has

(Continued on following page)

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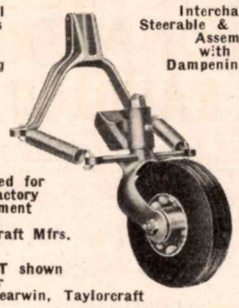

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(Continued from preceding page)

a department to remember these things. That is New Deal thinking.

In the matter of the pre-fabricated houses, made by the Currier Lumber Co. of Detroit which employs CIO labor, the AF of L Building unions in the Detroit area threatened to strike against all defense building construction in that area, involving $50,000,000 of new plants. Thus the CIO was happy to build the houses, but the AF of L would go on strike if they were erected. And to stop the erection of less than a million dollars' worth of small houses, the AF of L threatened to go on strike and stop $50,000,000 of defense plant construction. Did the Government sternly put down this civil war between two labor unions? It did not. It gave in to the AF of L. Sidney Hillman, Associate Director of the OPM, has held up the housing contract, on which the Currier Company was low bidder.

A fight between CIO and AF of L has put the entire Army light tank production into jeopardy. Of course, the opinions and the squabbles of labor unions are more important to the safety of the country than the building of tanks. So to hell with the tanks! No New Deal politician dares suggest that we pass laws to make such sabotage of our defense work illegal. Neither Democrat nor Republican dares it for both are crawling for the labor vote.

A Job to Be Done

The Outs, seeing what political success this pandering has brought the Ins, haven't the political guts to declare that such strikes are no less than criminal acts, and should be treated as such. Thus instead of operating on the biggest cancer in our national body, the Ins and Outs squabble about some matter such as whether to arm our merchant ships or force them to go defenseless among Hitler's pirates on the high seas. That is largely shadow boxing. If our elected poltroons would just forget Hitler for a few days, and leave him for the British and Russians to look after for that time (which they're doing anyhow) Congress might have time to do a little needed surgery on our cancerous labor growth. More men, and more nations, die of internal diseases than they do of injuries inflicted externally. France, for example, had been sick for years with internal cancers, political and industrial. Hitler merely knocked down a chronic invalid. Dr. Roosevelt should do something with his own patient before the disease becomes chronic. Let him consult with Dr. Major Fleet of Consolidated who only last month said, "The government is going to have to quit kicking the aviation industry

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

around, brow-beating us with committees and constant labor trouble." And he might even call in Dr. Leroy Hill of Air Associates who said "Now it remains to be seen whether the defense mediation board is out to get production or universal compulsory unionization."

Under the handicaps of human selfishness and political dishonesty, the defense of this nation is staggering along to a crisis. The Defense Board estimates that more than 16 million men will be required to complete the present defense program. Apparently all they need do is to write their own ticket for how much they can gouge out of the taxpayers. During the first seven months of this year strikes caused a loss of nearly 16 million man-days of work in all industry including defense, which was five times the loss of an equivalent period in 1940. And don't forget that even when workers are not striking, aircraft executives lose precious hours every day wrestling with the labor problem when they could be putting their abilities to productive use of benefit to the country.

Rough Sledding Ahead

But this is only a starter. The labor boys are just beginning to get their teeth into the pie. Many of these noble "fighters in the battles now raging" were on Home Relief or the WPA for many years. They had a thin time of it then, and they are only beginning to realize that the fattest period of their lives is immediately in front of them. All they have to do is squawk and go on strike, and riches will be poured into their laps to placate them and bring them back to the factory.

But let the valiant factory fighter beware! Let him remember that Hitler also raised the status of the noble German workman. After Hitler came there was better pay, better working conditions, better housing for the German workman. There was even Social Security, which the German now realizes is also chiefly a tax. In fact, the security is for the future, if any; the tax is ever present, right now, jumping higher and higher as the Administration goes deeper and deeper into mounting debts made ever greater by increasing production costs caused by placating defense workers whose strikes in the end may cause the workers to pay out more in taxes than they get in increased wages.

And let the noble labor leaders of CIO and AF of L, recall that Hitler was a friend of labor. Such a friend that, before they realized it, they were all in one big happy family, working

(Continued on following page)

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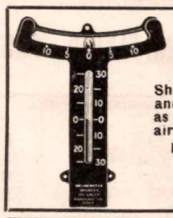

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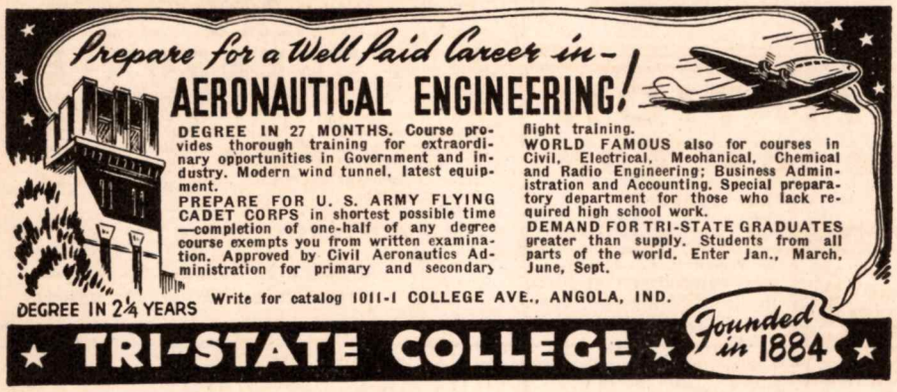

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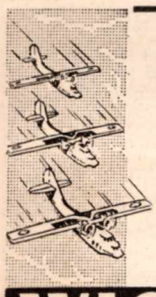

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(Continued from preceding page)

for the good of the Reich. There may come a time, and perchance soon, when Roosevelt will realize, as Hitler quite soon realized, that the noble working man has served his turn politically, and should be kicked into line. And it will be labor, itself, that has done the spade work of preparing the other citizens, the unorganized taxpayers, for this change.

Few today, outside of the ranks of organized labor, wouldn't declare that something should be done—something to curb this lawless predatory labor mob. It is not liberty the unions enjoy, but license to exploit the nation. And the rest of the nation is getting sore. When at last the full implications of this union sabotage of national defense is realized by the great mass of voters, the Administration will move to curb all labor. And it will be a popular move. When the unions cry, "Dictatorship!" the public will cynically remark that labor has long enjoyed a dictatorship of its own, which it has exploited ruthlessly, and with a savagery and a selfishness unsurpassed even by the economic royalists of the old horse and buggy days.

The Administration has been handling the labor situation with silk gloves, but this cannot go on. Racketeer-dominated labor has been going further out of bounds as its insidious demands are met again and again. But even an Administration weaned on the fat of the labor vote must jam on the brakes when it is threatening to undermine the existence of the country.

Boeing Graduates Army Men

(Continued from page 104)

Ill. Special attention is given during the six months' course to aircraft construction and repair, engine maintenance and repair, care of tools and materials, and the use, construction and testing of propellers.

Speers Buys Airtech

W. Arnet Speer, owner of Speer Flying Service, San Diego, has purchased Airtech Flying Service, Lindbergh Field, San Diego.

Airtech was founded in Sept., 1928, by Norman Lawson and Roy Campbell, Jr. It was the first operator on Lindbergh Field, and among the first Government-approved flying schools in the United States. For two years, United Air Lines hangared its transports and maintained its offices at Airtech, before building its own modern facilities on Lindbergh Field.

Servicing of airplanes, providing hangar space for private planes and operating a Government-approved flying school will be continued and expanded under the Speer management. Speer Flying Service will also continue its government and private instruction from Speer Field and at Oceanside, Calif.

See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

School Activities

Plains Airways, Cheyenne, Wyo., has taken delivery of five new ships including two Luscombe trainers and three Piper Cubs, for use in its schools at Cheyenne, Wheatland and the University of Wyoming at Laramie. The company now operates 40 planes.

* * *

A vocational education national defense sheet metal class designed primarily to train workers for the Martin bomber plant at Omaha, has been opened at Kearney, Neb.

* * *

A new private flying school has been organized at Casper, Wyo., by Jack Bingenheimer, Ed Drazik, Pete Schinone, Bill Lindenmeyer and Gordon Sutherland.

* * *

Capt. L. F. Wykert, commanding officer and supervisor of the Air Forces training detachment at the Lincoln (Neb.) Aeronautical Institute since Oct. 7, 1940, has been transferred to the Casey Jones School of Aeronautics, Newark, N. J., where he is taking command of the Air Forces training detachment. He was succeeded in Lincoln by Lt. C. E. Peterson, who has been assistant supervisor at the Lincoln school since last November. Lt. Robert B. Helfrich replaces Peterson.

Girls' College Offers Airline Courses

A course designed to familiarize young women with commercial airline operations and to point the way to the careers open to them in the industry has been inaugurated at Stephens College, Columbia, Mo.

Instructors from four airlines—Transcontinental & Western Air, Mid-Continent, Braniff and Chicago & Southern—will serve as guest lecturers of the course, the first ever offered in an American girls' school.

In a series of 17 lectures, airline representatives will discuss all phases of airline operations, including flight control, meteorology, passenger service, maintenance, communications, sales, and general office operation. The course will not include actual flight instruction.

James M. Wood, president of Stephens, reported that student interest in the course was so great that more than 300 girls sought to enroll, but that only 75 seniors were accepted because of the necessity of limiting the enrollment. Full scholastic credit will be given for the work, described in the college curriculum as "Aviation I." Coordinator of the course is Miss Marion E. Owens.

New Course

Dr. M. J. Thompson, chairman of the new aeronautical engineering department, University of Texas, announced last month that a master's degree in aeronautical engineering will be offered during the current term for the first time in the history of the school. Graduates will be qualified for positions in aeronautical engineering research.

New Schools Operating

The new Coleman Flying School, Ltd., located in Coleman, Tex., is now complete. Operations cover primary training of cadets, and the first group of fifty was from Ala-

(Continued on following page)

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See new "AERO *Equipment Digest*" department which begins on page 202 of this issue

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See page 199 for further information and address.

(Continued from preceding page)

bama. Land for the school was bought by the city from proceeds of a $60,000 bond issue. The school is built and operated by Harry A. Hammill, has a capacity of 200 cadets, two barracks, hangars and other buildings.

* * *

A new RAF training school is now in operation at Terrell, Tex., near Dallas. The school has a capacity of 150 cadets and is operated by Major Bill Long. L. H. Luckey is in direct charge at Terrell.

The RAF group is headed by Squadron Leader Andy Beveridge, who was assigned to the school as head liaison officer.

* * *

Riddle-McKay Aero College, at Clewiston, Fla., the third flight training center to be operated in that state by the Embry-Riddle organization, was opened informally late in September several days ahead of schedule.

A $500,000 project on a 2600-acre tract, the new field is an all-British flight training school where primary, basic and advanced flying will be taught. It is one of six such flight schools in the United States.

The first contingent of RAF cadets to reach the new field was transferred from the Riddle Aeronautical Institute, at nearby Arcadia; on Oct. 3, fifty additional cadets arrived from a Canadian reception center.

The new field has accommodations for 250 cadets, a staff of 250 and 75 training planes. G. Willis Tyson is in charge for the Riddle interests, with Squadron Leader George Burdick in command of the cadets.

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AERONCA CHIEF: Lycoming 65. Dual ignition. Position lights, battery, cabin heater, tailwheel, brakes, compass; de luxe interior; equipped for radio installation. New in January 1941; low number of hours. $1,750. Cincinnati Aircraft Service, Lunken Airport, Cincinnati, Ohio.

Beech

BEECHCRAFT C17B: Jacobs 285 hp. Manufactured 1937. Two-way radio. Total time 789 hours; only 30 hours since major. Excellent condition. Price $6,050. Inter City Aviation, Inc., East Boston, Massachusetts.

Culver

CULVER CADET: Franklin 80; 5 months old. 152 hours. Electric starter, battery, generator, navigation lights. Never scratched. Price new, $2,890. Sacrifice, $1,995. No trades. David E. Gaare, 1285 Cleveland Avenue North, St. Paul, Minn. Mi-7352.

Fairchild

FAIRCHILD: July 1936 Ranger 3-place cabin, in excellent condition. All instruments and navigation lights. $2,000; write or wire Richard Mark, Foshay Tower, Minneapolis, Minn.

FAIRCHILD 24K: New in November 1939; Ranger 165; 4-place. Turn and bank, rate of climb, Lear receiver, landing lights, flares, flaps. 275 hours total time; 100 since new style pistons and rings installed. Finished in Stearman vermilion and cream. This plane has had only one owner since new and is in excellent condition throughout. $5,700. Cincinnati Aircraft Service, Lunken Airport, Cincinnati, Ohio.

Howard

HOWARD 1940: Wasp Jr.; constant speed, two-way radio, landing lights, primary blind flying group. 130 hours total. New condition. For details address Seaboard Aircraft Sales, Roosevelt Field, Mineola, N. Y.

HOWARD 1940: 330 Jacobs; constant speed propeller, two-way radio, lights and flares, Sperry gyro, primary blind flying group. Beautiful condition. Approximately 200 hours total time. For details, Seaboard Aircraft Sales, Roosevelt Field, Mineola, New York.

HOWARD DGA-15J: Factory demonstrator with less than 150 hours' total time. Jacobs L6MB 330 hp engine; Hamilton Standard 2-position propeller; equipped for instrument flying, including 2-way RCA radio. Write or wire Howard Aircraft Corp., Chicago, Illinois.

Rearwin

REARWIN SPEEDSTER: 2PCLM. Total 395 hours, overhauled at 319 hours. 95 hp inverted Cirrus. Loening yellow, green trim. Pants, other extras. Cruises 115 mph. Privately owned, excellent condition, just relicensed. A steal at $1,575. Rearwin Aircraft, Kansas City, Kansas.

REARWIN SPORTSTER: 1939 Ken-Royce 90 hp with automatic pressure rocker box and valve lubrication, NACA cowling, steerable tailwheel, cabin heater, etc. Airplane and engine excellent condition. $2,295. Rearwin Aircraft, Kansas City, Kansas.

SKYRANGER: Continental 75 hp; blue with red trim, brakes, steerable tailwheel, cabin heater, dual ignition, etc. Few hours, excellent condition. New for $2,679; our price, $1,890. No trades. Will finance. Kansas City Airplane Finance Company, Fairfax Airport, Kansas City, Kansas.

Stinson

'34 LYCOMING RELIANT: Controllable prop, full instruments, two-way radio; 20 hours since major on airplane and motor. Complete cover job, white and red. $3,500. J. W. Canada, 2910 Sterick Building, Memphis, Tennessee.

STINSON VOYAGER: 90 Franklin; 100 hours, owner only user. Lear receiver, AMT-12 transmitter. power generator, starter, extras. $4,100 cash. Farwell Perry, Irvington-on-Hudson, N. Y.

Taylorcraft

FOR SALE: Taylorcraft Lycoming 55 hp Trainer. Never used for instruction; always privately owned. 147 hours. $1,500; no trades. Little Corporation, Patco Flying Field, Ridge Pike, Norristown, Pennsylvania.

Miscellaneous Aircraft

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WASP FAIRCHILD 71: Overhauled, on practically new Edo floats. Bellanca Pacemaker, new and used Edo floats. S-38, Wasp. Ranger V-12 engine. Walter K. Jaros, 48-03 Ditmars Blvd., Astoria, L. I., N. Y.

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WANTED: Stinson, 80 hp. Two 20-gallon tanks. Reasonably priced; give details. L. T. Sterling, 431 Florida Street, Vallejo, California.

WANTED: 3-5-place cabin airplane, 145-300 hp, recent major, not over 700 hours, blind instruments, radio, no crack-ups. Give price, delivered Seattle. AERO DIGEST, Box 3776.

WANTED: Pair Goodyear Airwheels and brake assembly 37 x 17-8 or 15.00-16. AERO DIGEST, Box 3780.

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1 Waco EGC-8 .....320 Wright	1 Howard DGA-8 .....350 Wright

1 Howard DGA-11.....450 Wasp Jr.

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TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENNESSEE. Written bids, in triplicate, will be received until 1:00 P.M., Central Standard Time, November 10, 1941, for the purchase from the Authority of the following airplane equipment: (1) Used Aircraft engine, Wright model R975E, 330 horsepower, 9 cylinder Radial Aircraft engine. Manufacturer's serial No. A13691, manufactured 11-30-29, equipped with Stromberg Carburetor NAR-9, 2 Scintilla magnetos, 1 Hamilton Standard metal propeller; (2) Used Metal propellers, Hamilton Standard, for 300 horsepower engines; (1) Used radio receiver, Westpoint Aircraft, standard range; (2) Used Bendix Aircraft wheels with brake assembly, each equipped with Firestone 6-ply 32 x 6 tires and tubes; (1) Used Bendix Aircraft wheel 32 x 6, without tires. This equipment is located at the Municipal Airport, Knoxville, Tennessee. For inspection see Tom O. Kesterton or James Wilson at the above address. Bidding documents, for which there is no charge, available October 14, 1941, at the above office. C. H. Garity, Director of Materials Department.

EDO FLOATS: 1 set used Model 4000 Floats and Float Gear; good condition. AERO DIGEST, Box 3788.

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ENGINEERING STRESS ANALYST capable of independent design and analysis of aircraft structures relating to power plant installations. Apply by letter to Installation Department. Applications not solicited from persons now employed in aircraft manufacturing industry. Pratt & Whitney Aircraft, East Hartford, Connecticut.

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ENGINEERING GRADUATES desiring opportunity to engage in field testing of airplane power plant installations. Depending upon previous experience, if any, applicants must anticipate two or three years of training in dynamometer testing and flight testing. Applications not solicited from persons now employed in aircraft manufacturing industry. Apply by letter to Installation Department. Pratt & Whitney Aircraft, East Hartford, Connecticut.

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Quarry Spotted

It was an American-built plane–a Catalina Flying Patrol Boat that brought the Nazi battleship Bismarck to bay. The Bismarck had struck a devastating blow at British morale when it sank the British battle cruiser Hood and then scurried for the shelter of a French port.

The hue and cry was on. The English were grimly determined that the Bismarck should not escape. British destroyers combed the seas. British planes searched until depleted fuel supplies forced them back to aircraft carrier or bases.

It was a plane built in America—a sleek, far-ranging "PBY" Consolidated Catalina, powered with two 1500 H. P. American-built Pratt & Whitney Engines, that spotted the quarry and radioed back to bring up the pack.

Somewhere among the 8,000 employees in the Thompson plants are men who shaped, machined and ground to five ten-thousandths of an inch accuracy the 28 sodium filled valves that functioned to keep the patrol ship aloft through long hours of searching.

To these shop men it was their job—a job well done—a "valve job" of skill and craftsmanship. Legend has it that "for want of a horseshoe nail" a medieval battle was lost—a kingdom conquered. Perhaps a bit of heat-dissipating sodium in a Thompson silcrome steel valve was a big factor in saving the honor of the British Navy May 27th, 1941.

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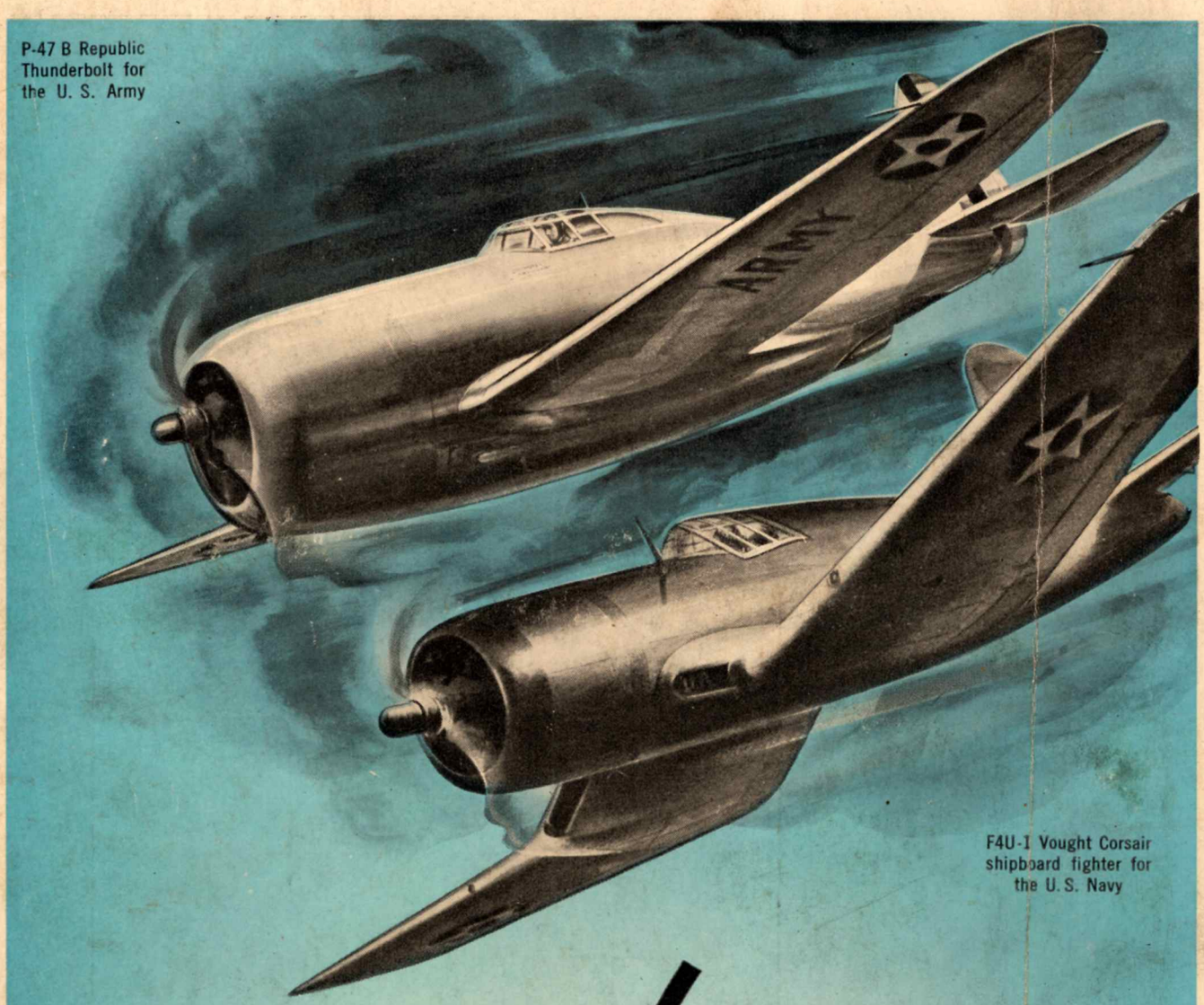

P-47 B Republic Thunderbolt for the U. S. Army

F4U-1 Vought Corsair shipboard fighter for the U. S. Navy

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